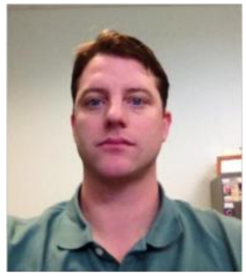
February 29 – March 1, 2012

Bill Prosser/NASA
Sponsor (S1-P1,P2)

George Studor /NASA
Chair (S1-P3,S4B-P4)



Eric Burke
NASA (S1-P4)

Michael Rollins
NASA (S1-P5)

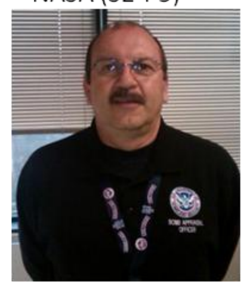
Eric Christiansen
NASA (S2-P5)

David Lafferty
BP (S2-P1)

Sergio Kapusta
Shell (S2-P2)

Peter Will
DARPA (S2-P3)

Robert Woods
DTRA (S2-P4)



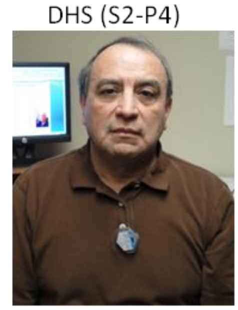
Nick Santoro
DHS (S2-P4)

Howie Choset
Carnegie Mellon (Lunch)

Reza Zoughi
MO Univ S&T (S3A-P1)

David Holbrook
Walleye Tech (S3A-P2)

David Zimdars
Picometrix (S3A-P3)



Arturo Reyes
Aribex (S3A-P4)

N. Shashishekhar
VJT (S3A-P5)

No Photo Available

Jon Lesniak
Stress Photonics (S3B-P1)

John Menner
Gen Magnetic Sci (S3B-P2)

Kevin McGusion
Excel Orbital (S3B-P3)

Aaron Parness
NASA (S3B-P4)

Ron Pelrine
SRI (S3B-P5)

Jason Geng
Xigen, LLC (S3C-P1)

Tom Kukowski
MinnesotaWire (S3C-P2)

Mohsen Shahinpoor
Univ of Maine (S3C-P3)

Ian Walker
Clemson Univ (S3C-P4)

In-Space Nondestructive Inspection Technology Workshop

February 29 – March 1, 2012
Gilruth Center Alamo Ballroom
NASA Johnson Space Center
Houston, TX

PURPOSE:
1. Assess NDE technologies and needs for on-orbit inspections of current & future spacecraft.
2. Discover and build on needs, R&D & NDE products in other industries and agencies.
3. Stimulate partnerships in and outside NASA to move technologies forward cooperatively.
4. Facilitate group discussion on challenges and opportunities for technology focus areas.

MOTIVATION:
Unplanned Events needing inspection: Apollo 13 Explosion; Shuttle Columbia Accident.
Risks for DOD, Commercial and NASA ISS Life Extension and Exploration missions.

WHO SHOULD ATTEND:
1. Inspection and NDE Communities
2. Gov and Commercial Space Organizations with In-Space Inspection challenges
3. Universities looking for relevant research and skills development areas
4. Technology Developers/Providers of the types of systems/applications below:

REGISTRATION: http://www.nasa.gov/offices/nesc/workshops/in_space_non_destructive.html

COST: For those who have ordered food, Pay cash at the door for Lunches & snacks - $25/day

TECHNOLOGY FOCUS AREAS:

Many inspection technologies are needed, however this workshop focuses on these 3:
- Miniaturized 3D Penetrating Imagers - looking through conductive material is biggest challenge
- Controllable Snake-arm Inspection systems - a smart endoscope that controllable base-to-end
- Miniature Free-flying Micro-satellite Inspectors - when you really need the viewpoint

SPONSOR:
NASA Engineering & Safety Center(NESC)
NDE Technology Discipline Team/Bill Prosser william.h.prosser@nasa.gov

CHAIR:
NASA/JSC/ES2 – George Studor george.f.studor@nasa.gov

CO-CHAIRS:
NASA/LaRC/Eric Burke eric.r.burke@nasa.gov
NASA/JSC/Ajay Koshti ajay.koshti-1@nasa.gov
BP/Dave Lafferty david.lafferty@bp.com

Workshop Coordinators:

On-site coordination

George Studor
Technology Development Staff
ES/Structural Engineering Division
NASA Johnson Space Center

Dr. Cara Leckey
Research Physicist
Nondestructive Evaluation Sciences Branch
NASA Langley Research Center

Carol Castle
Secretary
NASA Engineering and Safety Center
NASA Langley Research Center

Hope Venus
NASA IT Specialist
NASA Engineering and Safety Center
NASA Langley Research Center

Off-site coordination

Nga Pham
IT Support
LITES Contract
NASA Langley Research Center

Ian Batchelder
Applications Administrator
NASA Engineering and Safety Center
LITES Contract
NASA Langley Research Center

In-Space Non-Destructive Inspection Technology Workshop

Agenda

http://www.nasa.gov/offices/nesc/workshops/in_space_non_destructive.html

Feb 29th: 6:30-8:00am Check-in and Demo/Display Set-up

Session 1: Alamo Ballroom

1-1: 8:00-8:05am: Welcome/Logistics: NASA/NESC/JSC/Scott West, NESC/NDE/Bill Prosser

1-2: 8:05-8:30am: NESC NDE TDT & Future Human Spaceflight Missions - NASA/NDE TDT/Bill Prosser

1-3: 8:30-9:15am: In-Space Inspection Technology Needs/Vision - NASA/JSC/George Studor

1-4: 9:15-9:30am: SBIR/STTR Relevant Subtopics and Award Summaries - NASA/LaRC Eric Burke

1-5: 9:30-10:00am: MMOD Risk/Ext Inspection Needs for Re-entry TPS - NASA/JSC/Rollins/Christiansen

Break: 10:00-10:15am

Session 2: Alamo Ballroom - End User Needs Presentations

2-1: 10:15-10:40am: Oil & Gas Inspection Needs - BP Technology/NDE - David Lafferty

2-2: 10:40-11:00am: Oil & Gas Inspection Needs - Shell Technologies/NDE - Sergio Kapusta

2-3: 11:00-11:30am: Phoenix Mission Inspection Needs - BAA highlights - DARPA/Peter Will

2-4: 11:30-12:00am: Security Inspection Needs - DTRA/Robert Woods & TSA/Nicholas Santoro

Lunch 12:15pm - 12:45pm: Surgical Snake Robots & Tech - Carnegie Mellon/Howie Choset

Session 3:	**3A** **Alamo Ballroom East end** **Miniature 3D Penetrating Imagers**	**3B** **San Jacinto Room** **Misc Inspection Technologies**	**3C** **Alamo Ballroom West end** **Technologies for Flexible, Controllable Inspection**
3-1: 12:45-1:10pm	mm wave SAF Video MO S&T/Reza Zoughi	Direct Stress of Windows Stress Photonics/Lesniak	Stereo Videoscope Xigen/Jason Geng
3-2: 1:10-1:35pm	24-60 GHz Walleye/Dave Hollbrook	Sensing w/Magnetic Waves Gen Magnetic Sci/John Menner	Carbon NT Wire/Applications MinnesotaWire/T. Kukowski
3-3: 1:35-2:00pm	Hand-held T-Hz Picometrix/Dave Zimdars	M-Wave Inspection Exel Orbital/Kevin McGushion	Biomemetic/Ionic Polymer Tech for Snake Robots UMaine/Moshen Shahinpoor

3-4: 2:00-2:25pm	Backscatter Xray Aribex/Arturo Reyes	Gecko-foot Inspection Robots NASA/JPL/Aaron Parness	Tendril/Continuous Robots Clemson/ Ian Walker
3-5: 2:25-2:55pm	Imagery Noise Reduction VJ Tech/ N. Shashishekhar	Micro-Robotic Inspectors SRI/Ron Pelrine	Highspeed F.O. Strain for Shape NASA/DFRC/Patrick Chan

Break: 2:55-3:05pm

Session 4:	**4A**	**4B**	**4C**
	<u>Alamo Ballroom East end</u> **Miniature 3D Penetrating Imagers**	**<u>San Jacinto Room</u>** **Mini Free-Flying Inspection Satellites**	**<u>Alamo Ballroom West end</u>** **Controllable Snake-arm Inspection Systems**
4-1: 3:05-3:30pm	Backscatter Xray AS&E/Lou Wainwright	Mini-Aercam JSC/ER/Steven Fredrickson	Snake-robots/following S/W OCRobotics/Rob Buckingham
4-2: 3:30-4:00pm	Backscatter X-Ray Nucsafe/Dan Shedlock	SPHERES ARC/Mark Micire	3D Videoscope - next steps Olympus/Frank LeFleur
4-3: 4:00-4:30pm	3D Backscatter Xray POC/Victor Grubsky	Aerocube4 Aerospace Corp/Dave Hinkley	Snake Robot Inspection SRI/Ron Pelrine
4-4: 4:30-5:00pm	3D BX-ray & Adv DR GE/Rebecca Rudolph	ISS/Spacecraft Insp F.Flyer JSC/ES/George Studor	Art. Borescopes in Power Gen. GE/M&C/Joshua Scott

Dinner - Encourage small groups to meet together - End Users and Technology Providers

March 1:

6:30 - 8:00am Check-in and Demo/Display Set-up

Session 5: Alamo Ball Room End-User Needs Presentations

5-1: 8:00-8:30am Aircraft Inspection needs - Boeing Mfg/Assembly Technology/Jim Buttrick

5-2: 8:30-9:00am Backscatter Xray for Aircraft - Boeing/NDE/Gary Georgeson

5-3: 9:00-9:30am USAF Aircraft Inspection Needs - AFRL/ WPAFB /NDE/Stephan Russ

5-4: 9:30-10:00am Inflatable Habitat Inspection needs - JSC/Inflatable Tech/Gerard Valle

Break: 10:00-10:15am

Session 6: Alamo Ball Room End-User Needs Presentations

6-1: 10:15-10:40am Comp Pressure Vessel/Rocket Propulsion Inspections -WSTF/ Regor Saulsberry

6-2: 10:40-11:05am Under-water Inspection Mini-ROV Tech Needs - Astrotechnology/Dave Brower

6-3: 11:05-11:30am Spacecraft Prelaunch/Turnaround NDE Needs - KSC/NEL - Rick Russell

6-4: 11:30-12:00am Satellite Servicing Mission - Inspection Needs - GSFC/SSCO -Ben Reed

Lunch: 12:15-1:00pm Automotive Manufacturing NDE Inspection Needs - USCAR/NDE - Leo Lev

Session 7:

1:00pm - 3:00pm Scheduled One-On-Ones with End Users at their tables - sign up during workshop

(Sign-up Sheet will be at the Registration Desk - approximately 15 minutes per one-on-one meeting)

Break 3:00-3:15pm

Session 8:

8-1: 3:15-4:20pm Forward Planning Discussion Groups - Sign up beforehand please

8-2: 4:30-5:00pm Reports from Forward Planning Groups by designated lead

Closing: 5:00pm Closing Remarks - Comments from Participants

Miniaturized 3D Penetrating Imagers:

1. **NASA SBIR Subtopic** X5.04 Spaceflight Structural Sensor Systems and NDE http://sbir.nasa.gov/SBIR/sbirsttr2010/solicitation/SBIR/TOPIC_X5.html
2. N**ASA Tech Needs:** "In-Space Inspection Sensors Look Through Conductive Material to Target Surface" http://www.techbriefs.com/component/content/article/10507

Controllable Inspection Snakes:

1. Stereo vision and articulating head with lighting, variable stiffness along the length
2. SLAM - Simultaneous Location and Modeling Software - builds/uses the 3d model as it goes
3. Articulating snake robot - mechanical or piezo-control of the entire snake length
4. Sensors that sense contact and feed controls to alleviate it.
5. Snake real-time location - know/display the location of the entire snake
6. Self-following Software - each segment knows where and how to turn as it follows the head
7. Very small size, weight and power and work well Zero-g (assumed -standard for space stuff)
8. Length of at least 2 meters and diameter 3/8" or less
9. Minimum crew involvement/training - easy to use, hands-free, remotely operated
10. Ability to change imagers at the end, and/or add sensors/wireless sensors at the tip.
11. Eventually, we need the ability to grab items at the tip.

Free-Flying Inspectors: **1.** DARPA Phoenix BAA:
https://www.fbo.gov/index?s=opportunity&mode=form&id=b0e711adc7252f190ef5528a0a8faa1a&tab=core&_cview=1

2. NASA Franklin-Edison Small Satellite BAA
http://nspires.nasaprs.com/external/viewrepositorydocument/cmdocumentid=304776/solicitationId=%7B8D91056C-FD45-817A-3393-C9252FDF3326%7D/viewSolicitationDocument=1/Edison%20BAA.pdf

Session 7:

One-on-One Sessions (Tables): Locations To be assigned - See Registration Desk

NASA/JSC/ES, LaRC - In-Sapce NDE/SBIR	Ajay Koshti/Eric Burke
NASA/JSC/KX-ISS -Vehicle Ext Inspection	Michael Rollins
NASA/JSC -Human Spaceflight Exploration Team	Joenette Stecklein
NASA/WSTF -Pressure Vessels/Propulsion NDE	Regor Saulsberry
NASA/JSC/ES - MOD - Internal Inspections/Vision	George Studor
NASA/ARC -SPHERES Free-flyer Test bed	Mark Micire
NASA/ES - Inflatable Structures	Gerrard Valle
NASA/KSC NDE - Launch Site Inspection	Rick Russell
BP Techology/NDE	Lafferty/Dan Keck/John Nyholt
Shell NDE and Inspection	Sergio Kapusta
Astrotech	Dave Brower
DHS/DTRA/TSA	Woods/Santoro
GE - Articulating Borescopes for Power Gen Industry	Joshua Scott
Boeing - Aircraft Mfg/NDE	Gary Georgeson
USAF AFRL NDE	Stephan Russ
USCAR NDE	Leo Lev
Iowa State NDE Education Programs	Lisa Brasche
Olympus	Curtis Dickinson, Frank Lafleur
The Aerospace Corp	Dave Hinkley
GE - Inspection technologies	Rebecca Rudolph
Northrup Gumman/Newport News	Merle Eason
NASA Satellite Servicing Capabilities	Ben Reed/Ken Hodges
NASA/JSC Neutral Bouyancy Lab - Inspection Trng	

Session 8: Forward Planning Discussion Sessions

	Splinter Sessions	Location	POCs - To Be Assigned	Org
1	Future Workshops	Alamo Central -North		
2	University Programs	Alamo Central -South		
3	Mini 3D Backscatter X-ray	Alamo-West		
4	Penetrating 3D Imagers	Alamo-East		
5	Robotic Snake Inspectors	Alamo West		
6	Free-flying Inspectors	Food Break Area		
7	Supporting Technologies	San Jacinto Room		

Demonstration/Display Tables:

Table #	Organization	POC	What?
East End			
1a	Iowa State Univ/NDE	Linda Brasche	ISU Academics
1b	Astrotechnology Inc	Dave Brower	Mini ROV needs
2a	NASA/Free-flying Satellite Test bed	Mark Micire	SPHEREs/MiniAercam
2b	The Aerospace Corp	David Hinkley	Working Cubesat
3	NASA/JSC/MMOD Risk Assessment	Eric Christiansen	Damaged Samples
4a	NASA/JSC/Imagery Analysis Team	Michael Rollins	MMOD Impact Tile Array
4b	SRI	Ron Pelrine	Electro-Adhesion Material
5a	Univ of Maine	Moshen Shahinpoor	Ionic Polymer Muscles
5b	NASA JPL	Aaron Parness	Gecko Adhesive Material
Poster	NASA WSTF NDE	Regor Saulsberry	COPV/Propulsion NDE
North Side			
6a	General Magnetic Sciences, Inc	John Menner	Mag Wave
6b	Excel Orbital Systems	Kevin McGushion	M-Wave
7a	Walleye	Dave Holbrook	Hand-held 24 GHz
7b	Missouri Univ of Sci & Tech	Reza Zoughi	MM Wave SAF Realtime
8a	Picometrics	Dave Zimdars	H-held THz
8b	Aribex	Arturo Reyes	H-held Xray
Poster	NASA Human Spaceflight Expl Team	Jonette Stecklein	HAT Poster
9a	Physical Optics Corporation	Victor Grubsky	Backscatter Xray
9b	ViJay Technologies	N. Shashishekha	Image Processing/B-Xray
10a	Nucsafe	Dan Shedlock	Backscatter Xray
10b	AS&E	Lou Wainwright	Z Backscatter Xray
West End	North Wall		
11a	Xigen	Jasen Geng	Stereo Videoscope
11b	4DSP	Pierrez Vulliez	High Speed FO Strain
12a	DFRC High Speed Fiber Optic Strain	Patrick Chan	Real-time Shape
12b	OC Robotics -DTRA/NASA	Rob Buckingham	Snake Inspector Prototype
West End	West Wall - Right side of Screen		
13a	OC Robotics - UK	Andy Graham	New Robotic Insp Tech
13b	OC Robotics - UK	Andy Graham	New Robotic Insp Tech
West End	West Wall - Left Side of Screen		
14a	Minnesota Wire	Tom Kukowski	CNT Wire Production
14b	SRI	Ron Pelrine	Robotic Snake Tech
West End	Next to Dividers		
15	Olympus	Curtis Dickenson	Spaceflight systems
16	Olympus	Frank LaFleaur	Next Gen Endoscopes

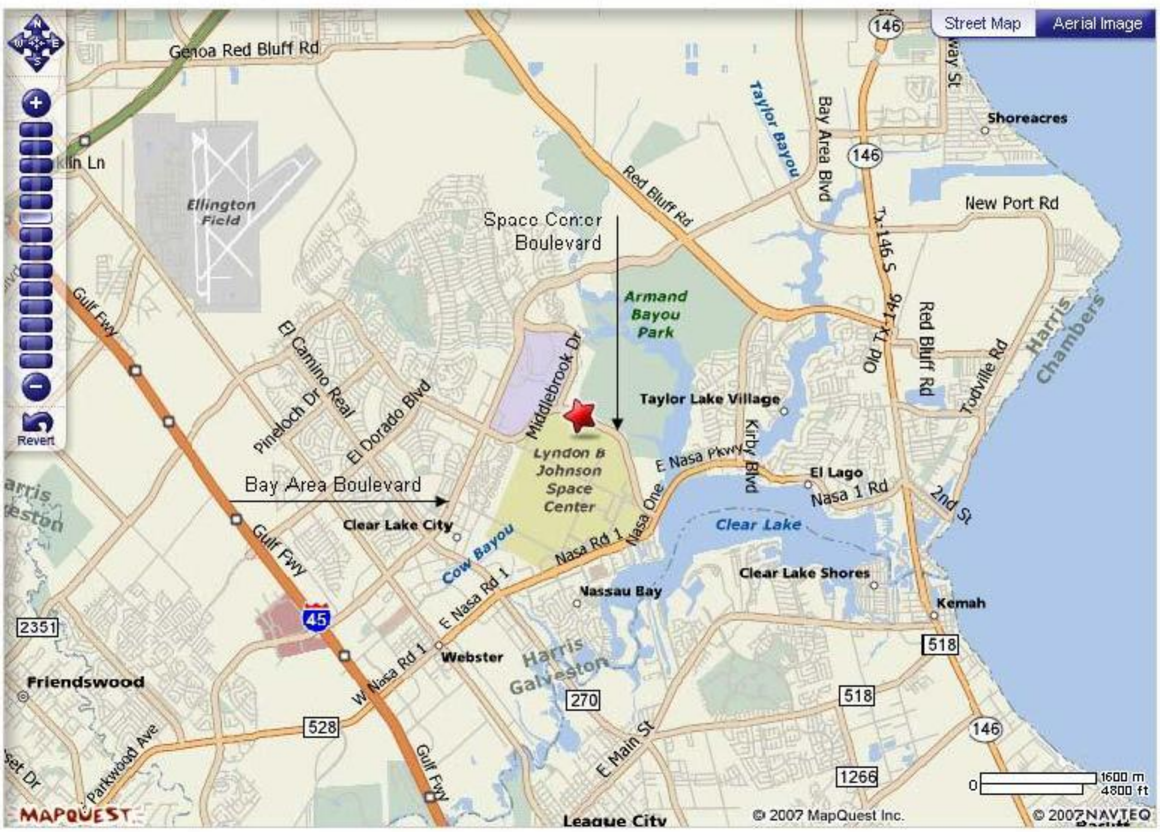
Maps and Directions: NASA Johnson Space Center, GilruthCenter

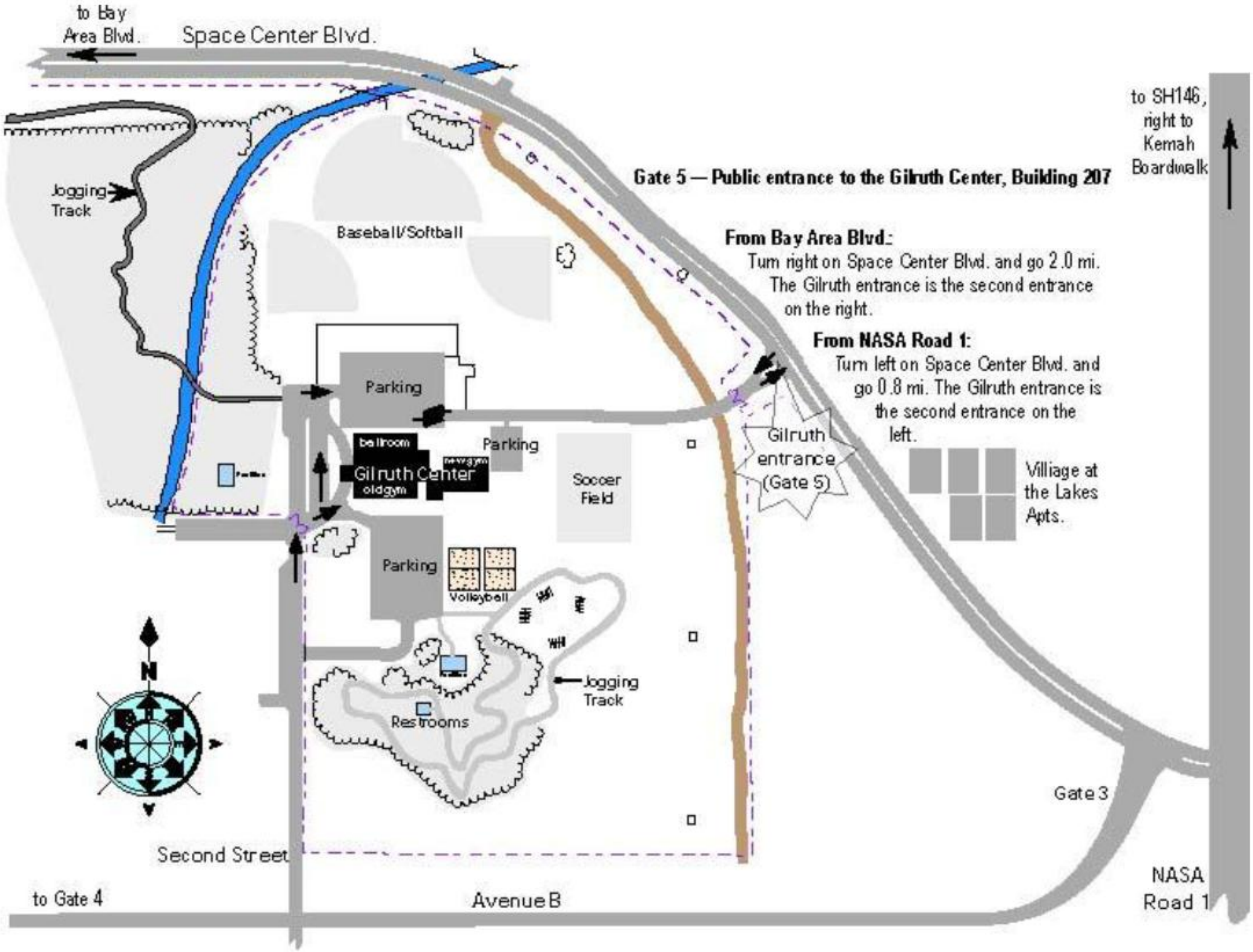
Traveling East from I-45 on Bay Area Blvd:

entrance on the right. (Gate 5)

Traveling East from I-45 on NASA Road 1:

not confuse this with Gate 3, which is the first entrance on the left. Figure 1: Map of Johnson Space Center





to Bay Area Blvd.
Space Center Blvd.
to SH146, right to Kemah Boardwalk
Gate 5 — Public entrance to the Gilruth Center, Building 207
From Bay Area Blvd.:
Turn right on Space Center Blvd. and go 2.0 mi. The Gilruth entrance is the second entrance on the right.
From NASA Road 1:
Turn left on Space Center Blvd. and go 0.8 mi. The Gilruth entrance is the second entrance on the left.
Jogging Track
Baseball/Softball
Parking
ballroom
Gilruth Center
oldgym
newgym
Parking
Soccer Field
Gilruth entrance (Gate 5)
Villiage at the Lakes Apts.
Parking
Volleyball
Jogging Track
Restrooms
N
Gate 3
Second Street
to Gate 4
Avenue B
NASA Road 1

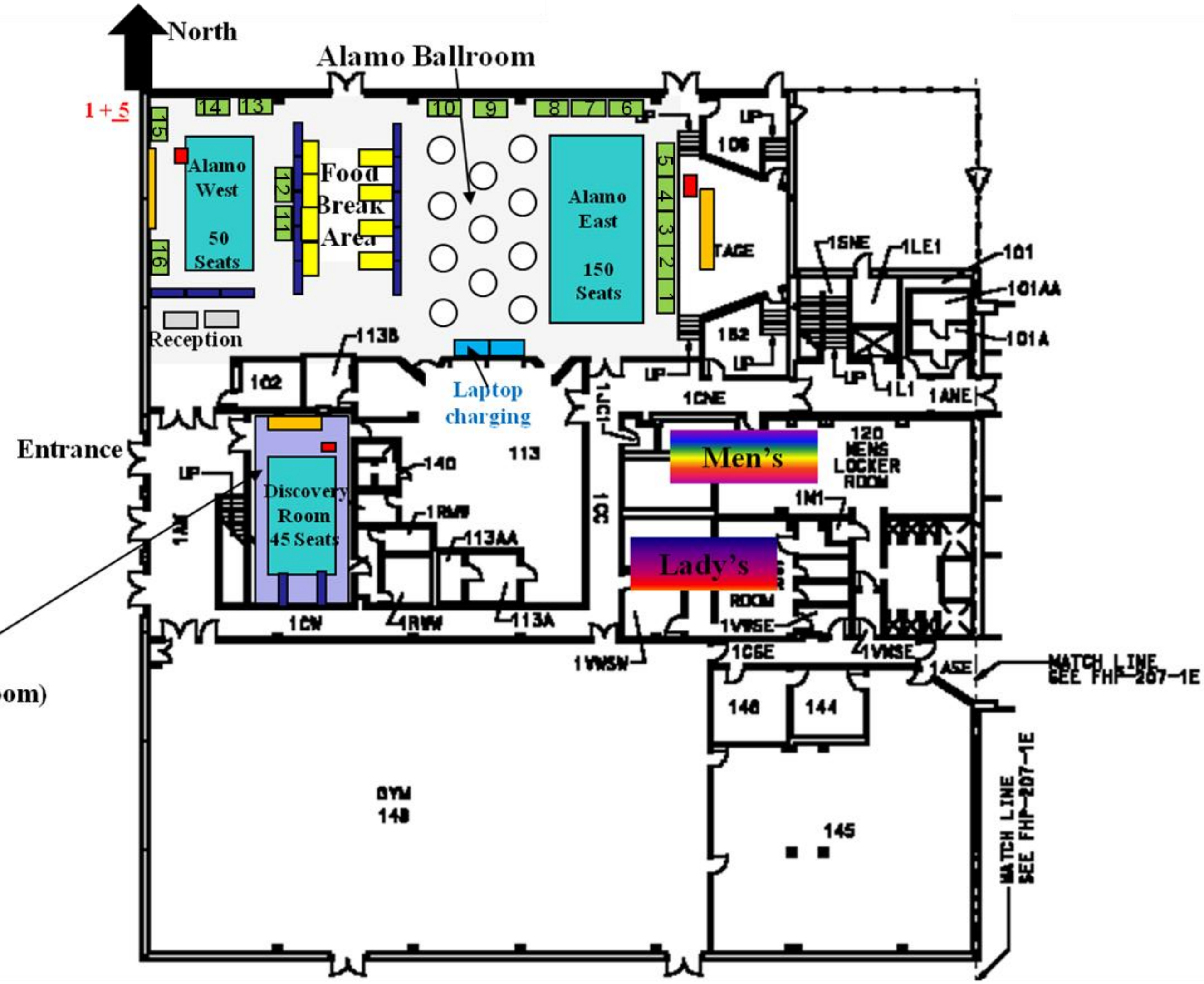
Gilruth Center First Floor

Inspection Workshop
Feb 29, 2012
Sessions 1,2,3,4

Beverage/Buffet & break area Tables

Reception Tables

Demo Tables (number counter clockwise from east to north to west)



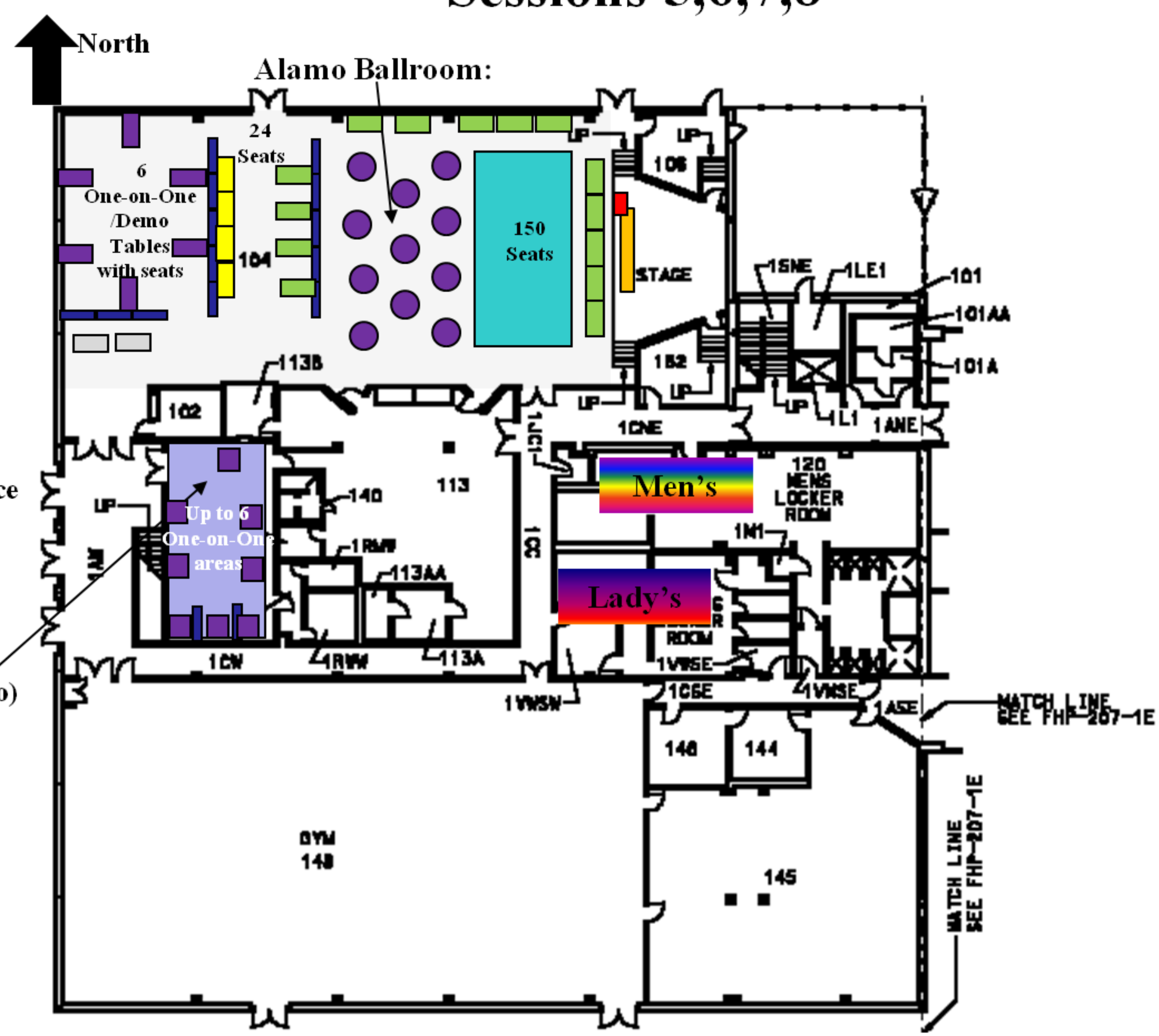
Discovery Room
(formerly San Jacinto Room)

-Parking is allowed anywhere except the few reserved spaces

- No badges are required

Gilruth Center First Floor

Inspection Workshop
Mar 1, 2012
Sessions 5,6,7,8



-Parking is allowed anywhere except the few reserved spaces

- No badges are required

Area Restaurants:

- **Perry's Steakhouse & Grille** (281) 286-8800
  487 Bay Area Boulevard, Houston, TX
- **Perry's Italian Grille** (281) 488-2626
  1001 Pineloch Drive, Houston, TX
- **Tommy's Restaurant & Oyster Bar**
  2555 Bay Area Blvd, Houston, TX 77058-1521
- **Carrabba's Italian Grill** (281) 338-0574
  502 West Bay Area Blvd., Webster, TX 77598
- **Mogul Indian Restaurant** (281) 480-3097
  1055 Bay Area Blvd, Houston, TX 77058
- **Mediterraneo Market & Café** (281) 333-3180
  18033 Upper Bay Road, Nassau Bay, TX 77058
- **Aquarium** (281) 334-9010
  410 Bagby Street Houston, TX 77002
- **Cadillac Bar** (281) 334-9049
  #7 Kemah Boardwalk, Kemah, TX 77565
- **Lighthouse Buffet** (281) 334-3360
  #3 Kemah Boardwalk Kemah, TX 77565
- **Landry's Seafood House (**281) 334-2513
  #1 Kemah Boardwalk, Kemah, TX 77565
- **Saltgrass Steak House** (281) 538-5441
  #4 Kemah Boardwalk, Kemah, TX 77565
- **RED Sushi & Hibachi Grill** (281) 334-6708
  #9 Kemah Boardwalk, Kemah, TX 77565
- **Bayside Grille** (281) 334-5351
  #11 Kemah Boardwalk, Kemah, TX 77565
- **The Flying Dutchman** (281) 334-7575
  #9 Kemah Boardwalk, Kemah, TX 77565
- **Joe's Crab Shack** (281) 334-2881
  #8 Kemah Boardwalk, Kemah, TX 77565
- **The Pizza Oven** (281) 334-2228
  #8 Kemah Boardwalk, Kemah, TX 77565
- **Restaurants - Kemah Boardwalk (about 15 minutes from JSC)**
  http://www.kemahboardwalk.com/

  Directions: 6.5 miles / ~15 minutes
  NASA Johnson Space Center to Kemah Boardwalk
  1. Head **EAST** on **NASA Pkwy E** 4.7 mi
  2. Turn right onto **TX-146 S/Bayport Blvd**
  Continue to follow TX-146 S 1.5 mi
  3. Turn left onto **6th St** 0.2 mi
  4. Take the second left onto **Bradford Ave** 0.3 mi
  5. Turn left at **Kemah Water Front**

Session 1 Presentation 2 **Dr. William H. Prosser**
"NESC NDE TDT Overview/Prior In-Space NDE" **NASA NDE Technical Fellow**
william.h.prosser@nasa.gov **NASA Langley Research Center**
(757)864-4960 **NASA Engineering and Safety Center)**

Abstract: The NASA Engineering and Safety Center (NESC) was charted in the wake of the Space Shuttle Columbia accident to serve as an Agency-wide technical resource focused on engineering excellence. The objective of the NESC is to improve safety by performing in-depth independent engineering assessments, testing, and analysis to uncover technical vulnerabilities and to determine appropriate preventative and corrective actions. Critical to the NESC are teams of experts in a number of core disciplines including nondestructive evaluation (NDE). These teams, designated Technical Discipline Teams (TDTs), draw upon the best engineering expertise from across NASA and also include partnerships with other government agencies, national laboratories, universities and industry. An overview of the NESC NDE TDT will be presented along with a brief review of previous applications of In-Space NDE by NASA.

Background: Dr. Prosser joined NASA Langley Research Center in 1987 as an Aerospace Technologist in the Nondestructive Evaluation Sciences Branch. In 2005, he joined the NASA Engineering and Safety Center as Discipline Expert for Nondestructive Evaluation and in 2007 was named a NASA Technical Fellow. He has served as technical lead and program manager for the research and application of NDE and Structural Health Management (SHM) systems for aerospace vehicles. Dr. Prosser's research has been in the field of ultrasonic and acoustic emission sensing techniques. His work contributed to the successful development and implementation of a system to detect impacts on the Space Shuttle wing leading edge in response to the Shuttle Columbia accident. He has led NASA, industry, university and government agency teams to implement NDE and SHM systems for a variety of NASA programs including the Space Shuttle, International Space Station, X-33, and Aerospace Vehicle Systems Technology Program.

Dr. Prosser was the 1997 recipient of the NASA Floyd Thompson Fellowship, a 2003 recipient of a NASA Superior Accomplishment Award for efforts during the Columbia Accident Investigation, and a 2005 recipient of NASA's Exceptional Achievement Medal. He is past Chair and a Fellow of the Acoustic Emission Working Group and is also the Scientific Editor of Structural Health Monitoring: An International Journal.

Dr. Prosser received his B.S. degree in Math and Physics from the College of William and Mary and his M.S. and Ph.D. degrees in Materials Science and Engineering from Johns Hopkins University.

Session 1 Presentation 3
"In-Space Non-Destructive Inspection Vision"
Demo: No Poster: No
One-on-One Table: Yes

George Studor
NASA/Johnson Space Center
ES/Structural Engineering Division
george.f.studor@nasa.gov
(763)208-9283

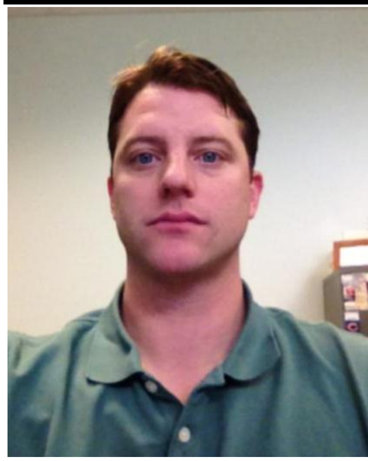
Abstract: NASA's heritage of addressing the extreme risks of spaceflight are legendary, however a when the appropriate in-space inspection method was not available, we suffered. NASA almost lost Apollo 13 and crew, we lost the MIR space-station in just 20 minutes, and we lost Columbia and its crew. Today we have an international space station to maintain, commercial crewed vehicles that need to address the same risks while adding efficiency, and we are preparing the technologies that will allow human-kind to travel farther from home. This presentation will cover the rational and vision for the 3 main Non-Destructive Inspection technology themes of this workshop with examples to understand the needs. With full support of the NASA Engineering and Safety Center's NDE Technical Discipline team, George will address the importance of industries and agencies working together - beginning here at the workshop with trust-building information and relationship development. He will address the opportunities for advancing the technologies needed, methods of the workshop, expectations and outcomes.

Background: Mr. George Studor is a senior project engineer for technology applications the Structural Engineering Division at the Johnson Space Center. Early in George's career, he guided requirements development and plans for Space Shuttle Orbiter's ground inspections. Then, after leading the Shuttle Program Plan Schedules for return-to-flight after the Challenger accident, he led the Space Station Freedom Verification Program. Prior to the Columbia accident, George managed the Sandia development and flight of LDRI, a 3D LADAR video system for in-space structural dynamics measurements. This system was matured after the Columbia accident to conduct inspections of the wing leading edge in all lighting conditions. In part of the International Space Station Leak Detection and Repair Project, George managed to ISS hand-held leak detection system in orbit. More recently, he has been investigating penetrating imager technologies for characterizing damage in space structures such as re-entry tile, and metallic, composite and fabric walls of manned pressurized modules. His experience also includes a large number of add-on stand-alone wireless instrumentation systems on spaceflight missions and advocates change in aerospace vehicle architectures to enable reduced wires and connectors through a comprehensive approach called "Fly-by-Wireless".

History:
- 1995-Present - NASA/JSC: Structures & Avionics Engineering Divisions, Technology Office
- 1993-1995 - NASA/Montana State University Adjunct Prof.
- 1990-1993 - NASA/HQ/Reston - Space Station Freedom Verification Program
- 1983-1990 - NASA/JSC - Space Shuttle Program Office
- 1987-1999 - AF Reserve AFRL - Retired Major
- 1972-1987 - Active Duty, USAF C-130 Pilot, USAF Detailee at NASA/JSC,
- 1981-1982 - MS Astronautical Engineering, USAF AFIT
- 1972-1976 - BS Astronautical Engineering, USAF Academy

Session: 1 Presentation: 4
Spaceflight Structural Sensor Systems and NDE
Demo: No Poster: No
One-on-One Table: No

Eric Burke
NASA/Langley Research Center
Researcher
Eric.R.Burke@nasa.gov
(757) 864-7724



Abstract: There is a need for modular lightweight, low power multifunctional interrogation systems. These systems can that reduce or eliminate wiring. Smart in-situ sensor systems provide real time or as needed interrogation of complex material and structural systems. Systems developed under this subtopic are flexible in their applicability. These systems should allow for additional future changes in instrumentation late in the design/development process and enable relocation or upgrade on orbit. They reduce the complexities of standard wires and connectors and enable sensing functions in locations not normally accessible with previous technologies. They allow NASA to gain insight into performance and safety of NASA vehicles as

of these systems could directly affect observations on the health of the thermal protection

Background: Mr. Burke is a research physicist at NASA Langley. Mr. Burke specializes in reserch in cutting edge non-destructive eveluation techniques and real-time detection. In addtion Mr. Burke is the Spaceflight Structural Sensor Systems and NDE small business innovative research

that will b
non-
large structures and flight hardware.

Experience:
SBIR Lead Manager for Spaceflight Structural Sensor Systems and NDE
-The international space station will fly past the design life of the vehicle. Combine with the increasing amount of in orbit debris and future deep space missions the need for in flight damage assessment is increasing. In this program I am guiding companies and technologies to a usable in flight ready status.
•Lead Engineer for Develop of Inspection for Light Weight Composite Payload Shroud
-Development of scalable methods for inspection of large scale composite material intended for inclusion into payload shroud for future NASA vehicles.
-Lead a team of engineers to develop and deploy multiple inspection technologies on a large scale composites to provide manufacture quality feedback.
-Currently program was so successful that several agencies including MSFC are looking to deploy duplicate systems based on this design.
-Required a large amount of inter-center, inter-agency and manufacturer coordination and program management of which I have received awards for.
-Guide a LARSS (Langley Aerospace Research Student Scholars) student to successful competition of his program and on to graduate school.
•Lead NESC Engineer for Assessment of Stress diffraction measurements for ET-137
-During the tanking of ET-137 a substructure stinger tore loose and liberated a section of SOFI foam from the structure. I was asked by the NESC to lead an investigation to develop a method of stress characterization through e SOFI foam.

Session 1 Presentation 5
"MMOD Inspection Needs for Re-entry TPS"
Demo: Yes Poster: No
One-on-One Table: No

Dr. J. Michael Rollins
Image Analyst
JSC-KX/ESCG
john.m.rollins@nasa.gov
(281) 483-1262

Abstract: Micrometeoroid and Orbital Debris (MMOD) impacts represent a significant risk for crews of long-duration space missions for which the spacecraft must perform a safe reentry. In order to protect the crew, the reentry vehicle is covered with one or more forms of thermal protection system (TPS) material able to withstand reentry heating. However, MMOD impacts that leave sufficiently large (i.e. "critical") TPS damage can result in loss of crew or vehicle. In order to mitigate the risk of loss of crew or vehicle, a full-surface image-based inspection or "survey" can be performed. Findings from the survey can lead to a "focused" inspection requiring specialized close-range imaging assets, and possibly to a repair or a safe-haven transfer of the crew. Design of appropriate survey and focused-inspection sensor packages requires prior impact and thermal

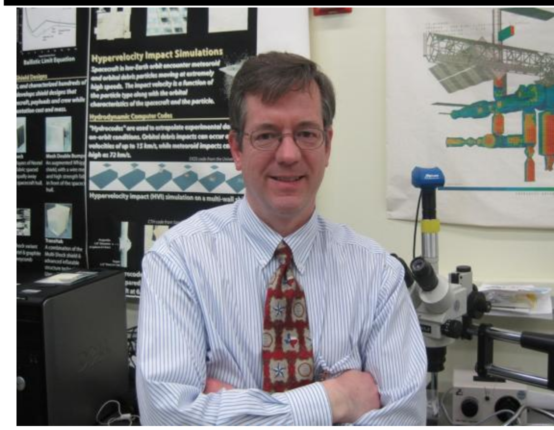
criteria. As-built sensor packages should be verified with subjective screening tests, with the sensors under appropriate environmental conditions. The timing and frequency of in-space inspections should be based on assessment of risk and risk-mitigation (due to inspection), derived from mission-specific MMOD flux and impact modeling.

Background: Michael Rollins supports the Image Science and Analysis Laboratory primarily in the field of on-orbit spacecraft inspection. His inspection work has included Space Shuttle

post-mi
and 3D imagery assessments for current and future on-orbit inspection applications. Michael has worked in image processing for 20 years, with 13 of those at Johnson Space Center. Other work has included correlation-based pattern recognition and imagery application development

Engineering from Texas Tech University, an MS in Electrical Engineering from the University of Texas, El Paso and a PhD in Electrical Engineering from New Mexico State University.

Session 1 Presentation 5 **Dr. Eric Christiansen**
"MMOD Risk and Resulting Inspection Needs for Re-entry TPS" **NASA/Johnson Space Center**
Demo: Yes **MMOD Protection Lead**
Poster: No **Eric.L.Christiansen@nasa.gov**
One-on-One Table: No **(281)483-5311**



Abstract: Micrometeoroid and Orbital Debris (MMOD) impacts represent a significant risk for crews of long-duration space missions for which the spacecraft must perform a safe reentry. In order to protect the crew, the reentry vehicle is covered with one or more forms of thermal protection system (TPS) material able to withstand reentry heating. However, MMOD impacts that leave sufficiently large (i.e. "critical") TPS damage can result in loss of crew or vehicle. In order to mitigate the risk of loss of crew or vehicle, a full-surface image-based inspection or "survey" can be performed. Findings from the survey can lead to a "focused" inspection requiring specialized close-range imaging assets, and possibly to a repair or a safe-haven transfer of the crew. Design of appropriate survey and focused-inspection sensor packages requires prior impact and thermal testing to determine critical damage criteria, and should be guided by standard detection criteria. As-built sensor packages should be

conditions. The timing and frequency of in-space inspections should be based on assessment of risk and risk-mitigation (due to inspection), derived from mission-specific MMOD flux and impact modeling.

Background: Dr. Eric Christiansen is the NASA lead for MMOD protection. He has developed and patented low-weight and highly effective MMOD shields used on the International Space

high-risk

TPS materials. His work lead to adopting operational techniques to reduce MMOD risk to NASA spacecraft, such as selecting low-risk attitudes/flight orientations, and using TPS

radiator panels for ISS and Shuttle. He is currently working on technologies to integrate impact

functions into MMOD shields such as thermal and radiation protection.

1989-Present: NASA Johnson Space Center
1985-1989: Eagle Engineering, Inc., Houston, TX
1982-1985: E.I. du Pont de Nemours & Company, Inc.
Education: 1979 - BS Chemical Engineering, Purdue University

Session 2 Presentation 1	**Dave Lafferty**
“Oil & Gas Inspection Needs ”	**BP**
Demo: No Poster: No	**Chief Technology Office**
One-on-One Table: Yes	**david.lafferty@bp.com**

Abstract: BP’s operations are worldwide and have a wide range of non-destructive inspection challenges. In-space and oil/gas NDE inspections are similar in that they both have to perform in very hostile locations. This talk is about explore some of the current NDE inspection needs and see if there are mutual interests with the in-space inspection community.

Background

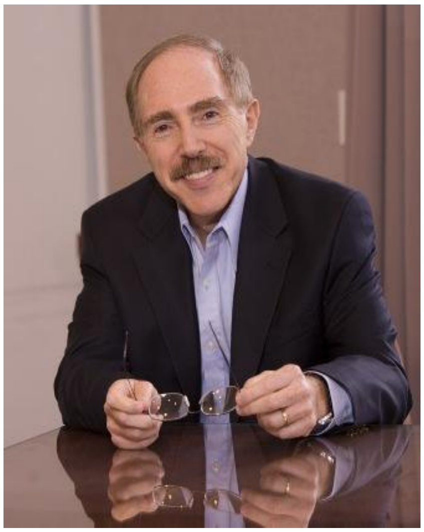
Since joining BP’s Information Technology and Services (IT&S) Chief Technology Office in 2004, Dave Lafferty has spearheaded a wide range of innovative projects including:

- Established and maintains a “Business Partnership” between CTO and the Alaska business unit resulting in the introduction of many innovations
- Developing the “Digital Umbrella” concept as a template for industrial wireless backhaul within BP
- Enhancing safety and operations using 3D virtual environments – including the award winning Virtual Hazard Monitor.
- Transforming the Location Intelligence concept into the various business solutions including the Alaska Pipeline Renewal Compliance tool.
- Award-winning Wireless Measurements systems using “motes” resulting in reducing industrial instrumentation cost an order of magnitude.
- Numerous integrity management systems including leak detection and corrosion measurements including the North Slope wireless corrosion project and the cross segment realtime corrosion measurement program.
- Predictive Analytics for both equipment health and supply chain optimization
- Geo-fencing projects including perimeter defense for the North American refineries and a Pipeline Intruder Detection System
- Handheld projects including Operator Rounds Mobility with embedded work rules
- Representing BP in the creation of the new ISA100 industrial wireless standard

For ten years before joining BP, Dave owned a consulting firm in Anchorage, Alaska providing IT consulting and project management services. Projects included business continuity planning

Session 2 Presentation 2
"Inspection needs in the oil and gas business"
Demo: No Poster: No
One-on-One Table: Yes

Dr. Sergio Kapusta
Shell International E&P Inc.
Chief Scientist
Sergio.d.kapusta@shell.com
(713)501-7629



Abstract: Maintaining the integrity of our assets is crucial to assure the safe production, transportation and processing of oil and gas. These assets include oil and gas wells, transportation pipelines, manufacturing and processing facilities, terminals, tankers, etc. The oil and gas industry has overall a very good safety record but recent incidents have highlighted the need to be ever more vigilant of the integrity and safe operation of our assets. Remote monitoring of the condition of the assets is an important component of an asset integrity program, together with robust work processes and trained and competent people. This presentation focuses on the technology aspects and the needs of the industry.

Background: Dr. Sergio Kapusta is Chief Scientist for Materials for the Royal Dutch Shell Group. He is concurrently Manager of the Physics and Materials R&D group in Shell. He is interested in the application of advanced materials, nanotechnology, and novel sensing techniques to improve the operations and safety of oil and gas production facilities.

1983-Present: Shell
1980-1983 Rice University
Education: 1979 – PhD Chemical Engineering Rice University
2006 – MBA Rice University

Session 2 Presentation 3
"DARPA's Phoenix Program"
Demo: No Poster: No
One-on-One Table: No

Dr. Peter Will
DARPA
DARPA SETA
pmwill@sbcglobal.net
(650) 380-6188

Abstract: An overview of the new DARPA Phoenix Program will be presented. The goal of Phoenix is to make use of the assets of retired satellites in space in the GEO graveyard orbit. Some of their components are short lived but some are estimated to have >100 year lifetimes and all have incurred the cost of getting to GEO. Phoenix will build a new satellite from the components or "ashes" of the old by harvesting parts and refurbishing them with new guidance and control and communications capabilities derived from small satellites called satlets. The Phoenix program will lead to a change the space paradigm toward a lower cost renewal and servicing culture from the present expensive, disposable one. The presentation will include issues and applications of hyper-dexterous robot arms in Phoenix

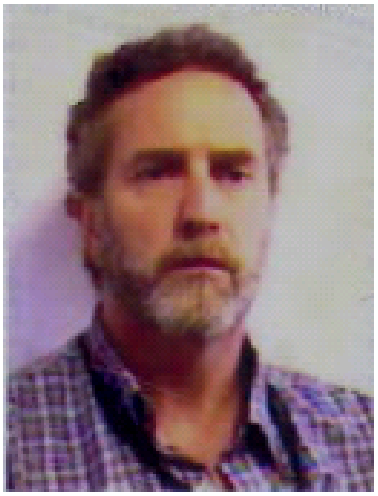
Background: Dr Will has 51 years post PhD experience as a research scientist, manager, business executive and university professor. He was awarded the Engelberger prize in Robotics in 1990. He holds 14 patents, one of which is the first patent to use the word pixel. He spent the year 2011 supporting DARPA TTO on the Phoenix Program.

His first work in aerospace in 1958 was in calculating re-entry nose cone thickness by simulated ablation. He invented grid coding now called structured light used in rendezvous and docking in space, on Mars rovers and to be used in the Phoenix program by NRL. He did the first digital rectification of Landsat imagery. He started and led IBM's robot project including gripper design, 6 DOF sensors for force and touch, sonar for occlusion detection all controlled by a real time operating system and a new High Level language AML. He took the project from concept to market in 8 years. It was used extensively in assembly and test on IBM's factories and was used by Apple in their assembly line for original Macintosh computer.

He was a founding member of DARPA's ISAT group; many time chairman of NSF advisory boards; two-term member of the National Research Council's Computer and Communications Advisory Board; a 4 year member of NASA's MARS Technology Review Board supporting the (just launched) 2012 MARS rover program. He served on many NSF selection boards for Engineering Centers and Presidential Young Investigators as well as research proposal panels. He served 4 years on NIST Review Board on manufacturing including one year as chairman and was a member of the NASA selection panel for robotic drilling on the surface of MARS.

Session 2 Presentation 4
“Security Inspection Needs“
Demo: Yes Poster: No
One-on-One Table: Yes

Robert Woods
Defense Threat Reduction Agency
Explosive Ordnance Research & Development
Robert.woods@dtra.gov
(910)243-6739



Abstract: Application of man portable light weight x-ray systems in extreme operating conditions and environments. Radiography as a technique to enhance security or conduct industrial inspections has many challenges when conducted out of doors and in remote locations. In addition to not always having a standard target to x-ray; environmental conditions, power requirements, source requirements, imaging requirements all affect capability, cost and schedule. There are no perfect solutions. The ideal system would be thin, lightweight, rugged, quick, easy to use, have no moving parts, and provide high spatial resolution images immediately without the need for processors. Ideally the system should be applicable to thick ferrous and thin non-ferrous materials x-rayed from a variety of distances from the source to the image capture system. All of these factors combined present a very unique challenge to using radiography for security and industrial applications in extreme environmental conditions or remote locations. The collaboration of extreme industrial radiography requirements with DOD security inspection requirements provides incentive for development of new technology and markets focused on meeting these challenges. My program efforts will focus on identifying requirements and developing relationships to identify solutions to meet these challenges.

Background: Mr. Robert Woods is a Defense Threat Reduction Agency Research and Development Program Manager focusing on technology, products and solutions for applications in Security and Explosive Ordnance Disposal (EOD). Mr. Woods is a retired USN Master Chief Petty Officer, Master EOD Technician with over 30 years of experience in military EOD requirements and R&D efforts. He has been with DTRA for over 10 years working with multiple government agencies and commercial vendors developing technology and solutions for unique EOD problems and mission sets.

Session 2 Presentation 4
"Security Inspection Needs"
Unattended baggage inspection system
Demo: No Poster: No
One-on-One Table: Yes

Nick Santoro
Department of Homeland Security
Transportation Security Administration
Explosives Operations Division
nicholas.santoro@dhs.gov

Abstract: Application of man portable light weight technology capable of seeing through unattended baggage in a personnel populated environment. Radiography as a technique to enhance security or conduct industrial inspections has many challenges when conducted in a populated area. In addition to not always having a standard target to x-ray; power requirements, source requirements, imaging requirements all affect capability, cost and schedule. Although x-ray systems are the common approach for seeing through items, alternate approaches should also be considered. The ideal system would be thin, lightweight, semi-rugged, quick, easy to use, have no moving parts, and provide high spatial resolution images immediately without the need for processors. Ideally the system should be able to interrogate hand-carry size bags inside an airport environment. The collaboration of extreme industrial radiography requirements with DOD and DHS security inspection requirements provides incentive for development of new technology and markets focused on meeting these challenges.

Background: Mr. Santoro joined the Transportation Security Administration, Explosives Operations Division (EOD) in January 2011 and is currently the Technology Officer. One of his primary roles is to act as a conduit between the field Transportation Security Specialist – Explosives (TSS-E) and the manufactures of specific equipment being utilized in the field. Such equipment includes; Ahura RM, HazMaster ID, and the DropEx kits as well as airport specific equipment such as; X-ray, WTMD, AIT, ATR, ETD, BLS, Saber 4000, FIDO, Liquid Test Strips, and any new technology introduced into the layered security process.

Prior to arriving at EOD, Mr. Santoro worked for the Joint Improvised Explosive Device Defeat Organization (JIEDDO), Air Force Center of Excellence (AFCOE) team as the Air Force Counter IED (C-IED) Program Manager. His responsibilities included oversight in managing task completion, reported requirements, and tracked work progression for the Training department. During Mr. Santoro's employment with JIEDDO, he was also the Senior EOD Ops Analyst prior to being promoted to the PM. He coordinated Air Force training efforts in C-IED defeat.

Prior to his employment with JIEDDO, Mr. Santoro was an EOD Project Officer with the U.S.A.F. Force Protection Battlelab responsible for the evaluation of new initiatives submitted for field deployment. Initiatives included technologies such as; Laser Induced Plasma Channel (LIPC), Ground Penetrating Radar (GPR), Infrared, Thermal Imagery Optical, Laser, High-Power Microwave Energy, and Chemical to name a few.

Mr. Santoro retired from the U.S. Air Force with twenty years of honorable service as an Explosive Ordnance Disposal Specialist. He was the EOD Flight Program Manager at two installations responsible for recruiting, training, and supervising all assigned personnel while enforcing policies and standards.

2011 – Present – DHS/TSA – Technology Officer
2006 – 2010 – JIEDDO – Air Force C-IED Program Manager
2005 – 2006 – USAF Force Protection Battlelab – EOD PM

Session: Lunch, Feb 29th
"Snake Robots for Confined Spaces"
Demo: No Poster: No
One-on-One Table: No

Dr. Howie Choset
Carnegie Mellon University
Robotics Institute
choset@cs.cmu.edu
(412) 268-2495

Abstract: Motivated by applications such as search and rescue, minimally invasive surgery, and aerospace manufacturing, my research group has built many novel high degree of freedom (DOF) systems, including snake robots. Snake robots are highly articulated mechanisms that can thread through tightly packed volumes and access locations that people and machinery cannot. We have used these robots as the focus of basic research in control, planning, and estimation. These research topics are important because once the robot is built (design), it must decide where to go (path planning), determine how to get there (motion planning), and use feedback to close the loop (estimation). Already, my group has directly applied this body of work to challenging and strategically significant problems in diverse areas such as surgery, manufacturing, infrastructure inspection, and search and rescue.

Background: Howie Choset is a Professor of Robotics at Carnegie Mellon University where he conducts research in path planning, motion planning, estimation, mechanism design, and hybrid controls. Much of this work has three foci: snake robots for search and rescue, manufacturing and medical robotics, multi-robot path planning for manufacturing and exploration, and coverage for de-mining and autobody painting. Choset directs the Undergraduate Robotics Minor at Carnegie Mellon and teaches an overview course on Robotics which uses series of custom developed Lego Labs to complement the course work. Professor Choset's students have won best paper awards at the RIA in 1999 and ICRA in 2003, he has been nominated for best papers at ICRA in 1997 and IROS in 2003, 2007, and 2011, best video at ICRA 2010, and won best paper at IEEE Bio Rob in 2006. In 2002, the MIT Technology Review elected Choset as one of its top 100 innovators in the world under 35. In 2005, MIT Press published a textbook, lead authored by Choset, entitled "Principles of Robot Motion." In 2006, Choset co-founded a medical device company called Medrobotics, Corp.

Recent Positions
1996-Present: Professor of Robotics, Carnegie Mellon
2006: Founder of Medrobotics Corporation
Education:
1990 – BSE in Computer Science/BSEcon Entrepreneurial Management, University of Pennsylvania
1991 - MS Mechanics Engineering, California Institute of Technology
1996 – PhD Mechanical Engineering, California Institute of Technology

Session 3A Presentation 1 **Dr. Reza Zoughi**
"Towards Real-Time 3D Microwave & Millimeter Wave Imaging" **MO Univ. of Sci. & Tech (S&T)**
Demo: Yes **Poster: No** **zoughi@mst.edu**
One-on-One Table: No

Abstract: Millimeter-wave signals span the frequency range of 30 GHz to 300 GHz, corresponding to a wavelength range of 10 mm to 1 mm. Signals at these frequencies can easily penetrate inside dielectric materials and composites and interact with their inner structures. The relatively small wavelengths and wide bandwidths associated with these signals enable the production of high spatial-resolution images of materials and structures. Incorporating imaging techniques such as lens-focused and near-field techniques, synthetic aperture focusing, holographical methods, robust back-propagation algorithms with more advanced and unique millimeter wave imaging systems have brought upon a flurry of activities in this area and in particular for nondestructive evaluation (NDE) applications. These imaging systems and techniques have been successfully applied for a wide range of applications. Ultimately, imaging techniques must be capable of producing real-time 3D high-resolution images using portable systems. However, there are several key technical issues that must be properly addressed for a portable real-time high-resolution 3D millimeter wave imaging system to become a reality. The ever-increasing advances made in various areas of technology development have fostered a conducive environment for significant and rapid gains in this area. In addition, advances in the development of fast imaging algorithms will ensure that real-time 3D millimeter wave imaging will be achieved shortly. All of this combined with a clear understanding of optimal achievable 3D resolution as a function of various system parameters, will provide much control and insight into the proper design of such systems for specific applications. In the past several years, significant progress has been made towards achieving this goal. This presentation provides an overview of advances made in this regard, along with a discussion of what is needed to complete the work.

Background: R. Zoughi received his B.S.E.E, M.S.E.E, and Ph.D. degrees in electrical engineering (radar remote sensing, radar systems, and microwaves) from the University of Kansas. He was at Colorado State University from 1987-2000. In 2001 he joined the Department of Electrical and Computer Engineering at Missouri University of Science and Technology (S&T), formerly University of Missouri-Rolla (UMR), as the Schlumberger Distinguished Professor. He is the author of the textbook entitled "Microwave Nondestructive Testing and Evaluation Principles", and the co-author of a chapter on Microwave Techniques in "Nondestructive Evaluation: Theory, Techniques, and Applications". He received the 2007 recipient of the *IEEE Instrumentation and Measurement Society Distinguished Service Award*, the 2009 American Society for Nondestructive Testing (ASNT) *Research Award for Sustained Excellence*, and the *2011 IEEE Joseph F. Keithley Award in Instrumentation & Measurement*. He is the co-author of over 478 journal papers, conference proceedings and presentations and technical reports. He has ten patents to his credit all in the field of microwave nondestructive testing and evaluation with two pending. He served as the Editor-in-Chief of the IEEE Transactions on Instrumentation

Session 3A Presentation 2
"A Handheld Millimeter Wave Imager"
Demo: Yes Poster: No
One-on-One Table: No

David Holbrook
Walleye Technologies, Inc.
dholbrook@walleyetechnologies.com
(781) 727-9412

Abstract: Millimeter Wave imaging systems have existed for many decades and have typically been large and expensive devices. The large size is commonly driven by the relatively long wavelengths of this spectral region as compared with optical or infrared imagers. The high cost has often been driven by image pixel count. The need to integrate RF electronics at each pixel drives system cost exponentially as field of view and resolution requirements grow. Walleye has developed a quasi-optical system approach that allows a single RF transceiver to be time multiplexed to form high pixel count images. The form factor of the device allows portability, light weight and low cost. We present the architecture of this new imager and discuss aspects of the beam path that optimize resolution performance.

Background: Mr. Holbrook has held several positions in engineering, project and technical management. His current role is CTO of Walleye Technologies, Inc where he has developed several sub-surface sensor and imaging platforms. Prior to Walleye he developed beam delivery and imaging solutions in the fields of laser micro-machining, photolithography and high energy ion implantation systems.

Additional Information: http://www.walleyetechnologies.com/technology-whitepapers/9-a-handheld-active-millimeter-wave-camera.html

Session 3A Presentation 3
"Hand Held Terahertz Imaging"
Demo: Yes   Poster: No
One-on-One Table: No

Dr. David Zimdars
Picometrix, LLC
Manager of Terahertz R&D
dzimdars@picometrix.com
(734) 865-5639

Abstract: Hand held time-domain terahertz (TD-THz) non-destructive evaluation (NDE) systems can be used to inspect space flight structures such as inflatable space habitats, thermal protection systems (TUFI-type tiles, SOFI TPS), and other components for voids, disbonds, and damage such as tearing and micro-meteorite impact. THz radiation in the range of 0.1 THz to 3 THz can penetrate these materials, and can be used to generate sub-surface images of these otherwise opaque or hidden structures. TD-THz reflection tomography is a single sided method, so it can inspect an inflatable habitat from the inside. Because the method is electromagnetic, it is inherently non-contact, and can penetrate vacuum (unlike ultrasound tomography), which is a significant advantage for the space based inspection of delicate structures such as polyurethane or silica foam TPS. The method of TD-THz reflection tomography employs near single-cycle sub-picosecond electromagnetic impulses that are generated and detected by the TD-THz instrument. These THz impulses are focused onto the object to be inspected. A small portion of the THz impulse reflects from the boundary of each material interface. These reflected pulses are separated in time, proportional to the thickness between the layers. The reflected TD-THz waveform is recorded, and the waveform is a representation of the sub-surface structure. In many ways, TD-THz reflection tomography is like an electromagnetic analog to ultrasound tomography (UT).

Background: Dr. David Zimdars is the Manager of Terahertz Research and Development at Picometrix. Since 2001, Dr. Zimdars has been the research and development manager for all terahertz scientific, industrial and homeland security product development contracts, terahertz analytical/imaging applications development, and terahertz manufacturing quality control applications development. He was a co-developer of the compact fiber optic coupled T-Ray 4000 modular time domain terahertz instrumentation system. Picometrix T-Ray 4000 and QA-1000 terahertz imaging systems have been deployed by NASA Michoud / Lockheed Martin to scan the space shuttle external fuel tank sprayed on foam insulation and orbiter thermal protection systems. The QA-1000 has been awarded the 2004 Photonics Spectra Circle of Excellence Award. He was a co-developer of the T-Ray 2000 THz spectroscopy and imaging system. Released in the in fall 1999, the T-Ray 2000 was the world's first commercially available time domain THz instrument. The T-Ray2000, due to its unique capabilities and innovative fiber coupled design, was given an R&D 100 award for and a Photonics Spectra award. He currently has over 32 papers and publications and several patents and patents pending.

Education: Stanford University, Ph.D. (Chemistry - *Chemical Physics*), 1996
Rocky Mountain College, B.S. (Chemistry), 1989

Professional Experience: Pres-2001 Manager of Terahertz R&D, Picometrix, LLC, Ann Arbor, MI
2001-1999 Research Scientist, Picometrix Inc., Ann Arbor, MI

Session 3A Presentation 4
"Three-Dimensional Backscatter X-ray Imaging"
Demo: Yes Poster: Yes
One-on-One Table: No

Dr. Arturo Reyes
Aribex, Inc.
Research Scientist
areyes@aribex.com
(801) 226-5522

Abstract: Many NASA applications as well as many industrial, military, security or medical applications, require images of the internal structure of objects. These are often obtained by transmission radiography. When access behind an object to be interrogated is not possible, only backscatter radiography can be used. The primary technical advance is to extend methods that normally supply backscatter 2D images through a sheet of material, to a 3D image with more complicated features at different depths, such as voids, cracks, corrosion, or delaminations. These innovations are two-fold. First, the use of a cone-beam x-ray source rather than a highly-collimated x-ray beam. This results in simultaneous collection of a larger field of view, significantly reducing the time to collect the full image. Second, by using multiple images from a collimated 2D detector array, 3D reconstructions can be performed, much like those done in computed tomography of transmission radiography.

Background: Dr. Arturo Reyes was educated in Mexico and at the University of Wisconsin in the United States. He received his PhD in Experimental Solid State Physics in 1989 from the Center for Research and Advanced Studies of the National Polytechnic Institute (CINVESTAV-IPN) in Mexico City. He has worked on the electrical and optical characterization of crystalline and amorphous materials, surface analysis techniques and laser Raman techniques for probing the degree of crystallinity of amorphous materials and the defects in single crystal semiconductors. As a Senior Scientist at MOXTEK, Inc., an x-ray company based in Orem, Utah, he studied x-ray diodes using silicon field-emission photocathodes, the investigation of plasmas generated in a capillary discharge as a possible "tabletop" x-ray laser, and the development of a simultaneous XRD/XRF instrument for the analysis of minerals for NASA. His work included the development of miniature filament and field-emission x-ray tubes. His latest work involves the development of backscatter x-ray imaging systems for non-destructive test applications.

2010-Present: Aribex, Inc. — Research Scientist
1992-2009: Moxtek, Inc. — Senior Research Scientist
1990-Present: Brigham Young University — Affiliate Faculty
1989-1990 – CINVESTAN (Mexico City) — Assistant Professor

Session 3A Presentation 5
"Visual Imaging and Software Post-Processing"
Demo: Yes   Poster: No
One-on-One Table: No

Dr. N. Shashishekhar
VJ Technologies, Inc.
R&D Manager
shekhar@vjt.com
(631) 589-8800 x1120

Abstract: Image processing of digital X-ray images is ubiquitous, ranging from simple image enhancements to complex automated image analysis techniques. This presentation explores techniques such as image registration, contrast enhancement, noise reduction and special filters within the framework of industrial X-ray applications. It also illustrates how image enhancement can help reveal significant information that is not easily discernible from the raw, acquired image.

Background: Dr. N. Shashishekhar ("Shaker") joined VJ Technologies in 1999 and manages the R&D group. The R&D group collaborates with several research institutes and universities in the development and application of new technologies.

He has a Ph.D. in Computer Science and Automation, and works in the areas of image enhancement, automated image analysis and computed tomography.

Session 3B Presentation 1
"Direct Stress of Windows"
Demo: No Poster: No
One-on-One Table: No

Jon R. Lesniak
Stress Photonics, Inc.
President
jlesniak@stressphotonics.com
(608) 224-1230

Abstract: The presentation will review the design and results of the Integrated Window Inspection Technology (IWIT) used to locate and identify space impact and damage sites on Space Shuttle windows after flight. Specifically, Stress signatures for chatter checks (handling damage), Hyper Velocity Impacts (HVI) and bruises will be discussed. The design of this unique photo-elastic, non-contacting instrument and its potential in-flight space applications as well as its possible commercial applications will be presented.

Background: Mr. Lesniak received his master's degree from the University Of Wisconsin Dept. Of Engineering Mechanics. He founded Stress Photonics in 1988 to develop stress and strain measurement techniques. He holds 10 patents in this area. He has managed several NASA funded SBIRS to develop and successfully commercialize thermo-elastic and photo-elastic stress measurement systems. He led Stress Photonics team for developing the Integrated Window Inspection Technology (IWIT) employed to locate and identify space impacts on shuttle windows.

Session 3B Presentation 2
"Sensing with Magnetic Waves"
Demo: Yes Poster: No
One-on-One Table: No

John Menner
General Magnetic Sciences
Chief Scientist
jmenner@genmagsci.com
(571) 243-6887

Abstract: Sensing through Ferro magnetic materials by manipulation of Wiess Domains with B fields

1. Definition of Wiess Domains

2. Applications of uses

3. Near barrier materials power requirements

4. Beyond barrier materials into formations

5. Filters using pulsed Wiess Domains

6. EM Wavelength compression using relative permeability

Session 3B Presentation 3
"M-Wave Inspection"
Demo: Yes Poster: No
One-on-One Table: No

Kevin McGushion
Excel Orbital Systems Inc
kevinm@exelorbital.com
(301)266-1505

Abstract: M-Wave is a technology hybrid developed from eddy current type devices. M-Wave uses a 2 coil design having a transmit and receive coil similar to a reflection type probe. However, with M-Wave both coils are brought to a resonant frequency in close proximity to one another often forming a characteristic 'M' shape. When these resonant frequencies are brought close, a sympathetic resonance develops between the two coils which greatly enhances both output and sensitivity.

This sympathetic resonance creates control frequencies where variables such as lift off, wall thickness and material type can be controlled. The enhanced sensitivity also allows inspection of graphite composite, plastics, air, chemicals and metals.

The M-Wave sensor is able to image through multiple walls of various materials and transition boundaries such as air and other materials in order to inspect a far side wall. M-Wave is able to image for voids in plastics and composites and the presence of insulators inside of an insulator of a different material.

Enhanced range is currently being developed to image at greater stand-off distances with improved resolution.

Background: Kevin McGushion founded Exel in 1989 on an invention which brought ultra high purity orbital welding to the Semiconductor, Biopharmaceutical and Aerospace industries. This invention lead to many other developments ranging in application from fluid handling components in the Semiconductor and Biopharmaceutical Industries to a magnetic imaging system and a novel manufacturing method for aircraft structural beams.

One of the premiere inventions (The Exel Imaging System) has been recommended for use by Boeing, in its RS68 Rocket Engine as well as passing 90/95 POD/CL acceptance criteria. Additionally the imaging system has proved to be a superior device for imaging graphite composite for Northrop Grumman's F-35 Program and is currently being evaluated by Spacex for their Falcon Rocket program.

In 2008, Kevin sold the Orbital Welding Division of Exel to Arc Machines, Inc. and today Exel is dedicated to developing and commercializing its new M-Wave Imaging Technology.

Session 3B Presentation 4 **Dr. Aaron Parness**
"Controllable ON-OFF Gecko Adhesives for LEO Applications" **NASA/Jet Propulsion Lab**
Demo: Yes Poster: No **Robotic Mobility Section**
One-on-One Table: No **aaron.Parness@jpl.nasa.gov**
(818) 436-9200

Abstract: ON/OFF adhesives can benefit multiple Earth orbit applications by providing the capability to selectively anchor two surfaces together repeatedly and releasably. Key to this new capability, targets will not need special preparation; ON/OFF adhesives can be used with cooperative and non-cooperative objects, like space debris. A space-rated adhesive that can be turned ON/OFF at will can benefit ISS inspection, Astronaut EVA, in space assembly, satellite servicing, and rendezvous and docking applications within the decade. JPL's adhesive mimics a gecko's adhesive system. Geckos adhere to surfaces using arrays of hierarchical hairs with features at the mm, µm, and nm scales that generate enough van der Waals forces to support the animal's weight. The directional bias of these hairs provides a means of turning the adhesion ON and OFF through an applied shear load, a behavior also seen in JPL's two-stage mm-µm synthetic structures. In practice, the applied shear load is generated through a slight sliding motion. Once activated in such a manner, a pad will resist both normal and shear forces aligned roughly to the loading direction. By arranging these pads in counterbalanced pairs, triads, or quads, omni-directional grip can be achieved, an architecture shown to a proof of concept level at JPL and employed by geckos when climbing on ceilings. The pads release with zero detachment force when the applied shear load is removed through the reversal of the slight sliding motion used to engage.

Background: Dr. Aaron Parness (Robotic Vehicles and Manipulators Group, JPL) is the Principal Investigator of the "Gripping Foot Mechanisms for Anchoring and Mobility in Microgravity and Extreme Terrain" project working on omni-directional anchors for both rough and smooth surfaces. He also leads a task on small reconnaissance robots for the military. Dr. Parness has over seven years of experience building and researching climbing robots. He has studied multiple methods of climbing, including insect-inspired approaches, gecko-inspired adhesives, electrostatic mechanisms, and mechanical interlocking methods like clawed climbing. His PhD dissertation at Stanford University is titled "Microstructured Adhesives for Climbing Applications". Dr. Parness also has experience in the design and fabrication of parts at the millimeter and micrometer scales. He is expert in Shape Deposition Manufacturing techniques and developed novel 3D photolithographic approaches to molding plastic parts for multi-length scale, multi material robotic applications. Dr. Parness also has expertise in mechatronics, and has constructed several autonomous robot prototypes. At JPL, he has worked for the Chief Technologist's Office and the MoonRise testbed in addition to his own research projects.

2010-Present – NASA Jet Propulsion Lab
2004-2009 – Stanford University

Session 3B Presentation 5
"Micro Robotic Inspectors"
Demo: Yes Poster: No
One-on-One Table: No

Dr. Ron Pelrine
SRI International, Robotics Laboratory
Chief Scientist
ron.pelrine@sri.com
(303) 834 8167

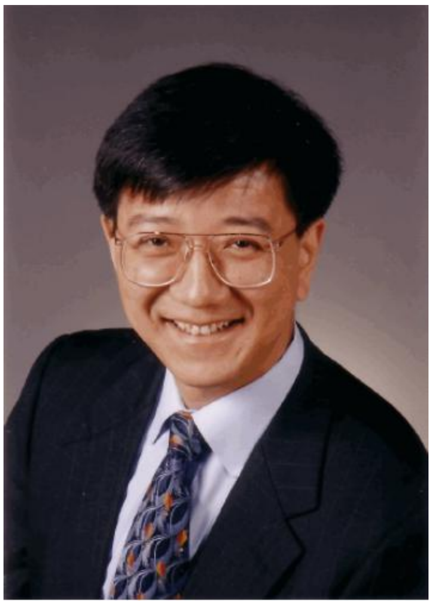
Abstract: The emerging field of micro robotics offers several unique opportunities for non-destructive inspection applications. Generally speaking, micro robots for NDI applications can be classified as freely mobile or constrained. Freely mobile micro robots include free flyers (discussed in other workshop sessions), and crawlers that move on spacecraft and other surfaces. Constrained micro robots rely on a macro robot to get them to the inspection site but may be mobile within the macro robot structure. This talk focuses on mobility mechanisms for freely mobile robots, and in particular the use of electroadhesion as an attractive low power method of maintaining traction on 3D surfaces. First demonstrated for earth-based wall climbing robots, electroadhesion scales well to smaller sizes and, unlike free flyers in space, consumes no propellant mass. Properly designed, a single electroadhesion pad can be used to electrically adhere to both insulators and conductors. Issues to be discussed include electronics, space compatibility, and design considerations for integrating electroadhesion to mobility mechanisms such as wheels and treads. We also briefly discussed developments in constrained micro robots that can be used as advanced end effectors with the ability to deploy multiple on-demand NDI tools.

Background: Dr. Ron Pelrine is Chief Scientist in SRI International's Robotics Laboratory. He has worked in robotics and related fields since 1986 and became an SRI Fellow in 2007. Dr. Pelrine has helped develop numerous robotic devices including pipeline inspection robots using novel magnetic wheels, wall climbing robots using electroadhesion, and levitated micro robots. He is a principal inventor of dielectric elastomers, an electroactive polymer (EAP) technology recently commercialized in consumer products. His chief interests in robotics has been novel mobility technologies ranging from magnetic wheels to electrostatic gripping (wall climbing) to levitation. Other interests include actuators, sensors, and energy harvesting. Dr. Pelrine currently has over 80 patents.

1982-1984: Shell Oil Company - Geophysicist
1989-Present – SRI International

Education: 1979 - BS Physics, MIT
1981 - MS Physics, University of Washington (Seattle)
1988 – Ph.D. Mechanical Engineering, University of Texas (Austin)

Session 3C Presentation 1 **Dr. Jason Geng**
"Stereo Videoscope" **Xigen LLC**
Demo: Yes Poster: No **jason.geng@ieee.org**
One-on-One Table: No **(301)910-9788**



Abstract: We provide an overview of state of the art three dimensional (3D) endoscopic imaging technologies. Physical objects in the world are 3D, yet traditional endoscopes can only acquire two-dimensional (2D) images that lack depth information. This fundamental restriction greatly limits our ability to perceive and to quantitatively measure the complexity of real world objects, as well as to understand the spatial relationship among them. In both medical imaging and industrial inspection applications, 3D surface imaging capability would add one more dimension, literally and figuratively, to the existing imaging technologies. Over the past decades, tremendous new technologies and methods emerged in the 3D surface imaging field. We provide a brief overview first. We then describe several 3D surface imaging techniques we developed in details, with representative designs and examples.

Background: Dr. Jason Geng has over 100 technical papers and one book published in the 3D imaging fields. He founded Xigen LLC, a Maryland-based company specialized in advanced 3D imaging and display technologies and products. He received the "Rising Star" award and ranked #291 by Deloitte & Touché on the lists of Fast 500 Growing companies in US and Canada. He also received prestigious national honors, including the Tibbetts Award from US SBA and was ranked #257 as INC magazine's INC 500 company. Dr. Geng was honored by DARPA as one of the 200 top scientists in US as the "Scientist helping America". He has served on review panels for National Science Foundation, National Institute of Health, and US Army Medical Research Commands. He is inventor of 23 issued patents. Dr. Geng currently serves as the vice president for IEEE Intelligent Transportation Systems Society (ITSS) and chairman of ITSS standard committee and ITSS membership committee.

Session 3C Presentation 2
"Carbon Nanotube Wire/Applications"
Demo: Yes Poster: No
One-on-One Table: No

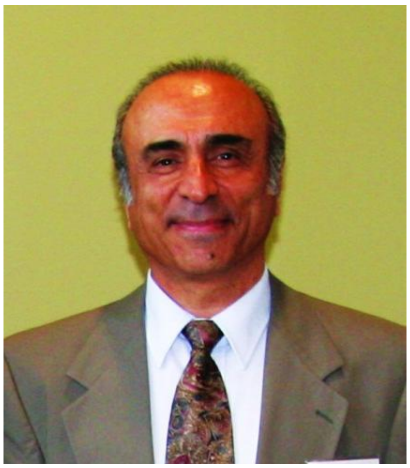
Tom Kukowski
Minnesota Wire
Manager R&D
kukowski@mnwire.com
(651) 659-6763

Abstract: Carbon nanotubes form conductive composites at low loading ratios and thus could be a key component in EMI shielding and conductors for lightweight aircraft wiring. Compared to conventional metal-based materials, electrically conducting polymer composites has attracted interest due to their light weight, resistance to corrosion, flexibility, and processing advantages. Minnesota Wire/Defense has demonstrated the feasibility of creating aircraft wires with the use of carbon nanotube sheets and yarns for shielding and conductors for producing lightweight wires. The primary goal of this effort is to advance the technology to the point where CNT shielded cables can be fielded on satellites and aircraft.

There are however many anticipated benefits and much potential for commercial applications for this development effort which are attractive to mechanical and thermal challenges. This innovation can be applied to reduce weight and improve resiliency beyond aerospace and commercial platforms including industrial, medical, transportation, and numerous electronic devices common to modern civilian living which we all have become dependent on.

Background: Tom Kukowski is currently the Manager of R&D for Minnesota Wire where he is responsible for developments focused on "adding value to aerospace wiring". Wire developments include prognostics health management, elastomerics, fatigue resistance, radio-translucence, MRI compatibility, patient comfort, as well as nanocomposites for EMI protection including Green chemistry utilizing super-critical fluid RESS spray technology. Most recent concentration has been towards design and process integration of CNT yarns and tapes into aerospace wiring for light weight coax, communications and single-primary cables. He has previous experience in research and product development for commercial systems, sensors, controls, and Class III medical devices for urology, vascular solutions and in-vitro diagnostics. He has worked for small companies as well as Fortune 500's including Hughes Aircraft, Honeywell and American Standards. Received a BSEE from the University of North Dakota in 1975.

Session 3C Presentation 3 **Dr. Mohsen Shahinpoor**
"IPMC Artificial Muscles Mechatronics-Future Prospectus" **University of Maine**
Demo: Yes Poster: No **Staff Strategic Planning & Partnering**
One-on-One Table: No **Mohsen.shahinpoor@maine.edu**
(207)581-2143



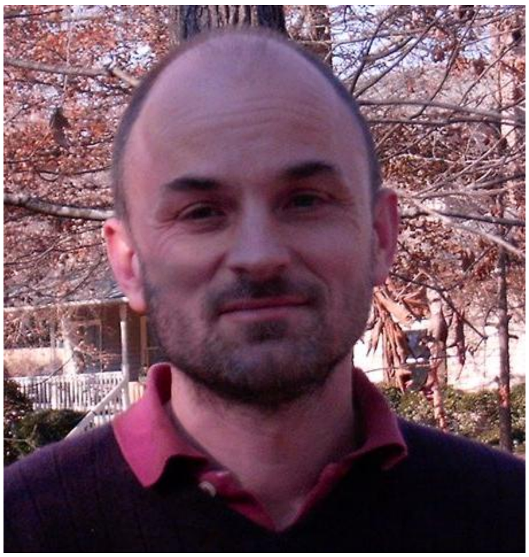
Abstract: I thank the organizers of this workshop on non-destructive inspection technologies to have given me a chance to briefly present my vision of the future prospectus in connection with ionic polymer metal composites (IPMCs) mechatronics. There is no doubt that IPMCs are electronic nano-composites of amazing properties. Our vision of the future of IPMCs can be summarized below in terms of both medical and industrial applications. Note that IPMCs are also excellent sensors that generate huge outputs in terms of milivolts and this can be used both for sensing, transduction and harvesting energy from incipient dynamics, wind or ocean waves. On the industrial side, due to the fact that the IPMCs are excellent sensors, energy harvesters and low-voltage actuators, they can be used for both sensing and simultaneous actuation for many engineering applications. In the energy harvesting and sensing modes they appear to have a very good bandwidth to sense low as well as high frequencies despite the piezoelectric materials such as PZT or Lithium Niobate that are only suitable for high frequency sensing. Two emerging visions of the future are to see IPMCs heavily used as a new probe in scanning probe microscopy and as robotic snakes for inspection. The future of IPMC sensors and actuators for inspection applications looks good (see also reference 1).

1-M. Shahinpoor and Hans-Jörg Schneider, " Intelligent Materials", Royal Society of Chemistry (RSC) Publishers, Science Park, Milton Road Cambridge CB4 0WF, Great Britain, 1st . Edition, (2008)

Background: Dr. Mohsen Shahinpoor is a Richard C. Hill Professor and Chair of the Mechanical Engineering Department at University of Maine. He is one of the inventors of ionic polymer metal composites (IPMCs) which are distributed nanoactuators, nanosensors, energy harvesters and nanotransducers. He is currently involved with the applications of IPMCs to medicine and robotic surgery but has also done a lot of work on industrial applications of IPMCs and in particular a new family of smart materials called "robomorphs" which can be used for inspection in very tight and constrained spaces.

Session 3C Presentation 4
"Biologically Inspired Trunk and Tentacle Robots"
Demo: No Poster: No
One-on-One Table: No

Dr. Ian Walker
Clemson University
Electrical & Computer Engineering
iwalker@clemson.edu
(864)656-7209



Abstract: There are many applications which feature complex and cluttered environments in which non-destructive inspection is desirable, but which conventional robots cannot negotiate. Thin continuous backbone "continuum" robot structures offer the potential to penetrate and gently explore narrow openings and complex obstacle fields. Inspired by biological counterparts such as elephant trunks and octopus arms, a new class of smooth profile, scalable and inherently compliant continuum robots is emerging. The talk will review the state of the art in continuum robots and discuss their potential for non-destructive inspection.

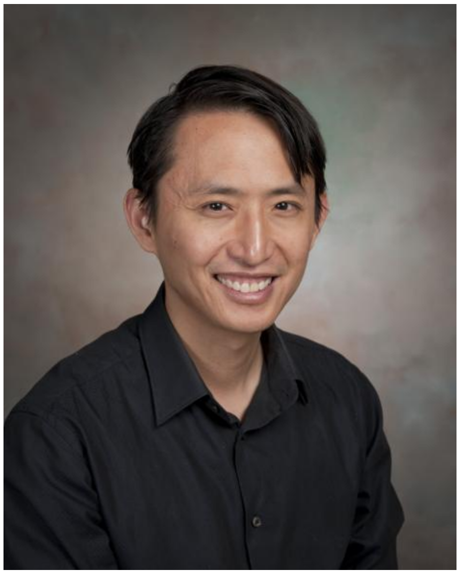
Background: Dr. Ian D. Walker is a Professor of Electrical and Computer Engineering at Clemson University. Professor Walker's research centers on robotics, particularly novel manipulators and manipulation. His group is conducting basic research in the construction, modeling, and application of biologically inspired "trunk, tentacle, and worm" robots. This work has been funded by NASA, NASA/EPSCoR, DARPA, and NSF. Professor Walker is a Fellow of the IEEE and a Senior Member of the AIAA. From 2006-2008 he served as Chair of the AIAA Technical Committee on Space Automation and Robotics.

1997-Present: Professor, Clemson University
1989-1997 – Assistant/Associate Professor, Rice University
Education: 1989 – Ph.D. Electrical Engineering, University of Texas, Austin
1986 – MS, Electrical Engineering, University of Texas, Austin

1983 –B.Sc., Mathematics, University of Hull, England

Session 3C Presentation 5
"Real-time Fiber Optics Strain and Shape Sensing Technology"
Demo: Yes Poster: No
One-on-One Table: No

Dr. Patrick Hon Man Chan
NASA/Dryden
Electronics Engineer (RS)
hon.chan@nasa.gov
(661)276-6170



Abstract: Fiber optics sensing system (FOSS) technology has been developed from NASA over the past decade where thousands of sensors can be interrogated onto a single strand of fiber, where environmental parameters such as strain or temperature can be measured. In this presentation a brief introduction of the technology will be given, as well as the advance of the technology in terms of miniaturization and acquisition speed. Deployment of the FOSS on flight environment will be discussed, and development of the technology for shape determination is showcased.

Background: Dr. Patrick Hon Man Chan is a fiber optics researcher at NASA Dryden Flight Research Center, working in improvement upon various aspects of current fiber optics sensing system (FOSS) for wide-spread deployment. He has a PhD in Interdisciplinary Material Science and Engineering from University of California, Irvine. Dr. Chan has published numerous journal papers related to fiber technology, and is currently working on all-fiber laser source as well as conducting research on shape-sensing fiber sensing technology.

2010-Present: NASA – Dryden Flight Research Center
Education: 2010 - PhD Interdisciplinary Material Science and Engineering, UC Irvine
2002 - MS Material Sciences Engineering, UC Irvine
2001 – BS Chemical Engineering, UC Irvine

Session 4A Presentation 1
"Three Different Approaches to Backscatter Imaging"
Demo: No Poster: No
One-on-One Table: No

Lou Wainwright
American Science & Engineering Inc
Mgr, Technical Market Development
lwainwright@as-e.com
(978) 686-1148

Abstract: X-Ray backscatter is a widely used technology for providing single-sided X-ray imaging of target objects. Because it does not require a film on the opposite side of the target, it is possible to create highly mobile systems that can be rapidly deployed in a wide variety of applications and locations. This talk will discuss three different types of backscatter imaging systems with wide ranging power and energy levels: the Z-Backscatter Van, AS&E's most successful product; the AXISS family, a coming product line of smaller modular backscatter systems with many deployment configurations; and a new portable backscatter prototype which is designed to be transported and used by a single person.

Background: Mr. Lou Wainwright is the Manager of Technical Market Development and the Product Manager for Advanced Concepts at American Science and Engineering. During the last five years at AS&E Lou has been the Program Manager for many government funded R&D programs for DHS S&T, TSWG, and TSA. He has also been the product and engineering manager leading AS&E's development of its upcoming line of miniaturized backscatter products. Prior to AS&E Lou worked in the semiconductor and medical device industries.

Session 4A Presentation 2	**Dr. Daniel Shedlock**
"X-ray Backscatter Imaging Aerospace Materials"	**Nucsafe Inc.**
Demo: Yes Poster: No	**Scatter X-ray Imaging Division**
One-on-One Table: No	**dshedlock@nucsafe.com**

Abstract: Scatter X-ray Imaging (SXI) is a Compton backscatter imaging (CBI) technique that uses a combination of first- and multiple-scatter components to generate high quality images at high speed at standoff distances that can vary from mm to meters. SXI has been applied to the detection of flaws and defects in aerospace materials and structures including cracks in airframe members, delamination, debonds and corrosion, especially on the surfaces of components with only single-sided access. Composite structures play an integral role in the high strength, light weight construction of aircraft. New non-destructive inspection (NDI) techniques are always needed for new materials. This paper summarizes the use of x-ray backscatter imaging to application of lightweight materials and structures in aerospace. This includes a summary of results from carbon-carbon composites, carbon fiber composites, and honeycomb-aluminum composite structures. In addition, results from micro meteorite damage will also be presented.

Background: Daniel Shedlock, Ph.D. is the VP and General Manager of Nucsafe Scatter X-ray Imaging (SXI) Division. Nucsafe's SXI™ division supplies x-ray backscatter equipment for both Non-Destructive Inspection (NDI) and security applications with products that range in size from one person portable systems to cargo scanning systems. Dr. Shedlock received his Ph.D. from the University of Florida where as one of the inventors of SXI technology he developed the inspection equipment for NASA's Return to Flight program in 2003. Before that, Dr. Shedlock was WMG, Inc's lead nuclear engineer and assisted in the Decommissioning and Decontamination (D&D) of the first five decimissioned nuclear power reactors in the United States.

2011 - Current: VP and General Manager of Nucsafe's SXI Division
2007 - 2011: Nucsafe Scatter X-ray Imaging Program Director
2004 – 2007: Ph.D. Graduate Research Assistant, University of Florida (UF)
2000 – 2004: MS. Graduate Research Assistant, Penn State and UF
1997 – 2000: WMG Inc. Lead Nuclear Engineer, Reactor Decommissioning

Education:

2007 - Ph.D. Nuclear Engineering Sciences, University of Florida
2003 – MS Nuclear Engineering and High Performance Computing, Penn State
1997 – BS Nuclear Engineering, Penn State

Session 4A Presentation 3
Compton Imaging Tomography: A New Approach for 3D NDI of Complex Components
Demo: Yes Poster: Yes
One-on-One Table: No

Dr. Victor Grubsky
Physical Optics Corporation
Director, Advanced X-Ray and Optical Technologies
vgrubsky@poc.com
(310) 849-6993

Abstract: In this presentation we will describe Compton Imaging Tomography (CIT), a novel nondestructive inspection (NDI) technique for reconstructing complete three-dimensional (3D) internal structure of an object, based on acquiring multiple two-dimensional Compton-scattered x-ray images. CIT is applicable to virtually any materials, including lightweight or composite structures and organics, which normally pose problems in conventional x-ray computed tomography because of low contrast. In addition to the traditional benefits of the backscatter x-ray approaches, such as one-sided operation, CIT provides true high resolution 3D tomographic data and allows inspecting deep layers of a structure. We will discuss the use of this new technique for NDI of aerospace components, composite structures, and other potential applications.

Background: Dr. Victor Grubsky is currently focused on the development of innovative x-ray and optical technologies, including non-destructive inspection and testing (NDI/NDT) systems based on x-ray scattering, terahertz sensors and components, lasers, and optical fiber devices and sensors. Another important area of his interest is the development of advanced image processing techniques, in particular for x-ray image enhancement. Before joining Physical Optics, Dr. Grubsky was primarily involved in the development fiber-optic components and systems for the telecommunications and sensor markets. At Sabeus Photonics, he developed optical components based on long-period fiber gratings with the best performance in the industry. As a Research Associate Professor at the University of Southern California, he demonstrated that glass microfibers can be used as a compact and inexpensive nonlinear medium for producing ultraviolet light via third-harmonic generation. Dr. Grubsky has co-authored nearly 80 scientific publications and 7 U.S. patents. He received a “Photonic Circle of Excellence” award in January 2003 for an innovative cold writing technology for manufacturing fiber Bragg gratings.

2006-Present: Physical Optics Corporation, Sr. Research Scientist/Director
2004-2006 – University of Southern California, Research Associate Professor
1999-2004 – Sabeus Photonics, VP Research & Development

Education:
1999 – PhD Physics, University of Southern California
1995 – MS Physics & Engineering, Moscow Institute of Physics and Technology

Session 4A Presentation 4
"3D Backscatter X-ray and Advanced DR"
Demo: No Poster: No
One-on-One Table: Yes

R. Rudolph, C. Bueno, W. Ross, A. Couture
GE Inspection Technologies, GE Global Research
Rebecca.Rudolph@ge.com, Bueno@ge.com
http://www.ge-mcs.com (646) 895 2937

Abstract: Relevant to this workshop**,** GE has been exploring backscatter and through-transmission x-ray techniques for oil and gas (O&G), security, and aerospace applications. For backscatter imaging, two approaches have been considered. The first approach employs an x-ray tube with up to 450 kVp energies that is combined with a GE Healthcare scintillator - PMT array to achieve high resolution results through thick structures. The second approach is based on extensive work completed at the Penn State University, Department of Nuclear Engineering[1] and employs a mono-energetic Hg-203 isotope (<1 curie) that is manufactured at the reactor on campus, and when combined with a NaI/PMT detector results in a single-sided, hand-held radiation safe backscatter wall thickness tool for corrosion under insulation. The prototype developed is 150mm diameter, 200mm long and weighs under 7kg.

For through transmission radiography, GE has demonstrated excellent corrosion and crack sensitivity for airframe inspection, and in particular lap joint interrogation using its industrial digital detector arrays, with portable x-ray tubes. This fieldable approach has been successful in imaging through aircraft side walls, overhead bins, insulation, and wiring to achieve comparable performance to exposures just through the metallic sub-structure. GE Global Research Center is working on the next generation of portable, rugged digital radiography detectors. Replacing the glass substrate used in current digital detector arrays with a flexible substrate such as plastic or metal foil will significantly increase the ruggedness and mobility of said systems. In addition, a flexible substrate could enable new applications in the areas of airframe, pipeline, and security inspection. Results on the above technologies will be discussed to foster further discussion for In-Space NDE.

Background: Becky is the North American Radiography Sales Manager for Academia at GE Inspection Technologies. She comes to GE from the Advanced Lithography Group at IBM's T.J. Watson Research Center and, most recently, the American Museum of Natural History where she was Head of the Microscopy and Imaging Department. Becky's expertise lies in understanding and working with a variety of different imaging modalities for materials characterization including electron microscopy, electron dispersive spectroscopy, confocal laser scanning microscopy, atomic force microscopy, and x-ray imaging.

Session 4B Presentation 1
"Mini AERCam for In-Space Inspection"
Demo: No Poster: No
One-on-One Table: No

Dr. Steven E. Fredrickson
NASA Johnson Space Center
Software, Robotics and Simulation Division
steven.fredrickson@nasa.gov

Abstract: The NASA Johnson Space Center Engineering Directorate has developed the Miniature Autonomous Extravehicular Robotic Camera (Mini AERCam) as a free-flying, robotic inspection vehicle intended for future external inspection and remote viewing of human spacecraft. The Mini AERCam technology demonstration unit has been successfully integrated into the approximate form and function of a nanosatellite flight system by leveraging the success of AERCam Sprint flight system and related free-flyer technology development. The Mini AERCam free flyer can be operated via remote piloting from a control station supporting teleoperation and supervised autonomous commanding, with functions such as automatic stationkeeping, point-to-point maneuvering, and automatic docking. Free-flyer testing has been conducted on an air-bearing table and in a six degree-of-freedom closed-loop orbital simulation, and enhancements have been made to provide additional capabilities for future space-based inspection. This presentation will provide a technical overview of the Mini AERCam development, including strategies for spacecraft integration.

Background: Dr. Steven Fredrickson serves as Chief of the Spacecraft Software Engineering Branch in NASA JSC's Software, Robotics and Simulation Division (ER). The branch is responsible for CMMI-rated spacecraft software engineering, vehicle systems management, GFE flight software development, and software technology development. Dr. Fredrickson's prior ER roles include Chief of the Intelligent Systems Branch, Assistance Chief of the Special Projects Office, Acting Chief of the Robotic Systems Technology Branch, and Mini AERCam project manager. In addition to leadership responsibilities, Dr. Fredrickson participates in various technical society activities, and has contributed over two dozen publications including a book chapter on small satellites. Dr. Fredrickson earned a Bachelor of Science Degree in Computer and Electrical Engineering from Purdue University (West Lafayette, IN) and a Doctor of Philosophy Degree in Robotics Engineering from Oxford University (Oxford, England).

Session 4B Presentation 2
"Synchronized Position Hold, Engage, Reorient, Experimental Satellites (SPHERES)"
Demo: Yes   Poster: No

Dr. Mark Micire
NASA/Ames Research Center
mark.j.micire@nasa.gov
(650) 604-4337

Abstract: SPHERES Engineering at NASA Ames provides sustaining engineering functions to ensure reliable and repeatable use of the SPHERES platform on station. Ground testing and flight program verification is provided to guest scientists at a testing facility that includes a large granite air-bearing table that simulates the configuration on station. The lab provides troubleshooting support, flight demonstrations in 2D, and verification of software packages prior to uplink to the ISS. In addition to supporting external research groups, the engineering support team assists in facility upgrades, configuration management, and technical documentation. During all ISS operations, representatives from the engineering team are actively involved in assisting operations to maximize experiment success and science return.

In the near future, the SPHERES Engineering facility will support real time commanding and data handling (C&DH) to the SPHERES on ISS and simulation of C&DH and operation concepts in our testing facility at Ames. The SPHERES core software is being released to an open source repository by MIT, and SPHERES Engineering will assist in the management of the integration and upgrading of the core software stack for the SPHERES and user interfaces as outside contributions are made. It is in the intent of our engineering facility to act as a catalyst and resource for continued research and development in free flying systems and C&DH advancements.

Background: Dr. Mark Micire has worked for over a decade to bring robots and other technologies to assist humans in dangerous tasks and extreme environments. He is currently a research scientist for Carnegie Melon University as an IPA to NASA Ames Research Center in Mountain View, CA. He is the Engineering Manager for the SPHERES National Lab Facility and Engineering Lead on the Human Exploration and Telerobotics project. In addition to his work with NASA, he is active in the search and rescue community and a technical search specialist and robot subject matter expert for the FEMA California Urban Search and Rescue Task Force 3.

Employment:

2010 - Present: NASA Ames Research Center
2006 – 2010: University of Massachusetts Lowell
2002 – 2007: President of American Standard Robotics

Education:

Ph.D. in Computer Science, University of Massachusetts Lowell, Department of Computer Science, December 2010.
Nationally Certified Fire Fighter. Hillsborough Community College, Fire Fighter Academy, December 2004.

Session 4B Presentation 3
"AeroCube 4"
Demo: Yes Poster: Yes
One-on-One Table: Yes

David A. Hinkley
The Aerospace Corporation
PICOSAT Program
david.a.hinkley@aero.org
310-336-5211

Abstract: The Aerospace Corporation Picosatellite program conceives, develops, builds, integrates, and operates picosatellites, nanosatellites, and miniaturized spacecraft and their subsystems utilizing the scientific and engineering capabilities existent at the Corporation. We advocate leveraging the quick cycle time to design, build, test, and fly picosatellites (about an order-of-magnitude shorter than the equivalent cycle for traditional DoD spacecraft) to quickly and iteratively evolve new space technologies and concepts as well as mission assurance processes that are applied to much more expensive and important but longer lead-time programs. We advocate changes in DoD policy and infrastructure to accommodate secondary payloads, which are crucial to rapid development of space technology (and for the education of the next space generation) and therefore for national space security, from an advantageous and comprehensive position within DoD space. We advocate using the low-cost aspect of miniature satellites to leverage the latest technology in electronics as well as demonstrate the most risky concepts in order to accelerate space technology development. This talk will show results from prior missions and list our latest capabilities.

Background: Mr. David Hinkley is a senior project engineer leading the Picosatellite effort at The Aerospace Corporation, called the PICOSAT Program. He joined the PICOSAT Program at the beginning in 1999 as a mechanical engineer and now is the principal engineer. In total, the PICOSAT program has delivered miniature satellites for 10 missions including 4 that used the space shuttle as a launch platform, with the help of the USAF Space Test Program.

1983-1989: B.S. Mechanical Engineering UCSD

1989-1991: M.S. Mfg. Engineering (Robotics) UCLA

1987-Present: The Aerospace Corporation

Session 4B Presentation 4 **George Studor**
"ISS/Spacecraft Inspection F. Flyer" **NASA/Johnson Space Center**
Demo: No Poster: No **ES/Structural Engineering Division**
One-on-One Table: Yes **(763)208-9283** **george.f.studor@nasa.gov**

Abstract: NASA continues to need autonomous inspection capability that can be deployed on demand, but with a minimum of spacecraft infrastructure required to accommodate its functions. By utilizing a combination of already funded programs and past investments, it is possible to develop a free-flying inspection cubesat stand-alone system that has the least number of interfaces and demands on crew or ground for operations. The SPHEREs testbed on ISS can develop fully autonomous inspection algorithms based on proven spacecraft inspection processes for the Space Shuttle after Challenger. These control and image processing algorithms can be then demonstrated on a ELV upperstage with the more sophisticated platforms like the Aerocube. By working directly with mini-AERcam prototype and operations/safety engineers at JSC, requirements for human spaceflight concerns can be incorporated into Aerocube and other cubesat vehicles. By adding active "peapods" to the cubesat deployment options, a standalone service can provide power, thermal control, communications and navigation for more versatile use of autonomous free-flying platforms. By providing guidance to the wide field of cubesat research, development and test communities, NASA can influence the TRL increases it needs to make these systems operationally affordable.

Background: Mr. George Studor is a senior project engineer for technology applications the Structural Engineering Division at the Johnson Space Center. Early in George's career, he guided requirements development and plans for Space Shuttle Orbiter's ground inspections. Then, after leading the Shuttle Program Plan Schedules for return-to-flight after the Challenger accident, he led the Space Station Freedom Verification Program. Prior to the Columbia accident, George managed the Sandia development and flight of LDRI, a 3D LADAR video system for in-space structural dynamics measurements. This system was matured after the Columbia accident to conduct inspections of the wing leading edge in all lighting conditions. In part of the International Space Station Leak Detection and Repair Project, George managed to ISS hand-held leak detection system in orbit. More recently, he has been investigating penetrating imager technologies for characterizing damage in space structures such as re-entry tile, and metallic, composite and fabric walls of manned pressurized modules. His experience also includes a large number of add-on stand-alone wireless instrumentation systems on spaceflight missions and advocates change in aerospace vehicle architectures to enable reduced wires and connectors through a comprehensive approach called "Fly-by-Wireless".

<u>History:</u>

1995-Present - NASA/JSC: Structures & Avionics Engineering Divisions, Technology Office
1993-1995 - NASA/Montana State University Adjunct Prof.
1990-1993 - NASA/HQ/Reston - Space Station Freedom Verification Program
1983-1990 - NASA/JSC - Space Shuttle Program Office
1987-1999 - AF Reserve AFRL - Retired Major
1972-1987 - Active Duty, USAF C-130 Pilot, USAF Detailee at NASA/JSC,
1981-1982 - MS Astronautical Engineering, USAF AFIT
1972-1976 - BS Astronautical Engineering, USAF Academy

Session 4C Presentation 1
"Industrial Snake-arm robots"
Demo: Yes Poster: No
One-on-One Table: No

Dr. Rob Buckingham
OC Robotics
Managing Director
rob@ocrobotics.com
(44) 117 3144700

Abstract: OC Robotics has been developing and selling snake-arm robots since 2001. This presentation will describe four activities in the nuclear sector including two successful projects at nuclear power plants in Sweden and Canada. These projects used purpose built snake-arms with 14, 21, 16 and 20 degrees of freedom and of varying length and function. Operational experience of using snake-arm robots for remote handling activities including grasping, handling, swabbing, water jetting, welding, laser cutting, swaging and sealing will be described. Work with DTRA on small diameter snake-arms of 0.5inch diameter will also be described.

Background: Dr. Rob Buckingham co-founded OC Robotics in 1997 with Andrew Graham. The company has focused on developing snake-arm robots that are specifically designed to operate in confined spaces. OC Robotics customers have included: Airbus, the Advanced Manufacturing Research Centre with Boeing, Areva, EDF, Ontario Power Generation, Sellafield, UK MOD and US DOD. Rob has been Managing Director of OC Robotics since 2001. Prior to OC Robotics, Rob was a lecturer at the University of Bristol and worked for the UKAEA at Culham Labs. He has a PhD in robotics from the University of Bristol and a BSc and MEng from the Special Engineering Programme, Brunel University, London and was a National Engineering Scholar. He is a Chartered Engineer and Fellow of the Institute of Engineering and Technology. In 2009, Rob was jointly awarded The Royal Academy of Engineering Silver Medal. In the same year OC Robotics won the Queen's Award for Enterprise and the British Engineering Excellence Award.

Session 4C Presentation 2
"3D Videoscope – next steps"
Demo: Yes Poster: No
One-on-One Table: Yes

Frank Lafleur
Olympus NDT
Product Manager – RVI/HSV Americas
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(713)897-1424

Abstract: Remote Visual Equipment has grown leaps and bounds, especially in the last 10 years. Olympus has been at the forefront of RVI innovation and continues to seek out and provide cutting edge solutions to the most demanding markets. Find out what technologies Olympus is currently using towards the goal of the 3D videoscope. Based on current and evolving technologies from Taper Flex, pneumatic articulation and micro gravity sensor, Olympus continues to drive innovation forward. What is the next step however? What will bring all these pieces together to provide a functional and repeatable piece of industrial and scientific equipment to answer the call of the 3D Videoscope. What do have to build off of, and who can help us get there.

Background: Mr. Frank Lafleur is the Product Manager for Remote Visual Inspection and High Speed Video equipment at Olympus NDT. With studies in Electro-Mechanical Robotics Engineering, and over 8 years in sales, operations and application support for capital equipment with intelligent control system, he strives to bring the market feedback into product advances. He is part of a team of very experienced professionals that gather information from all over the world, to direct an equally talented team of R&D Engineers to design and introduce the best technology to answer real world applications. Frank is responsible for coordinating the most demanding customer needs into current and future product reality for the Americas. Through his various fields of experience, he is able to grasp a great deal of facets to a customer's requirements, from overall business benefit, to operator ease of use. He is constantly looking for new synergies in Olympus existing products and possible partnerships to aid his long term goal of keeping Olympus NDT at the cutting edge of RVI.

1999-2004 University of Ottawa/Algonquin College of Applied Sciences - Mech Eng. / Electro-Mech Robotics Eng.
2004-2009 Operations and Application Support Specialist – Walter Meier Climate
2009-2011 Operations Manager – PWM Electronic Price Signs
2011-Present Product Manager RVI/HSV Americas – Olympus NDT

Session 4C Presentation 3	**Dr. Ron Pelrine**
"Snake Robot Inspection"	**SRI International, Robotics Laboratory**
Demo: Yes Poster: No	**Chief Scientist**
One-on-One Table: No	**ron.pelrine@sri.com**
	(303) 834 8167

Abstract: Hyperdextrous snake-like arms can be used for a variety of space inspection tasks, such as looking around or behind structures in tight spaces, or steering through the internal hatch or service bay of spacecraft. However, snakes or tentacles in space present many challenges in actuation and control. The high number of degrees of freedom presents challenges for control and packaging of actuators, and the long thin geometry in a cantilevered configuration makes applying loads at the end point particularly difficult. This talk describes several component technologies being investigated at SRI for applications to snake robots. Electroactive polymers (EAPs) is attractive for direct drive simplicity of snake robots, yet lifetime of EAP actuators at high performance remains a challenge. More recent work with electrostatic clamps and clutches may reduce the number of actuators needed by "time-sharing" actuation using lightweight, on-demand mechanical coupling to a mechanical power source. In addition, related electrostatic clamping technology may be able to rigidize all or parts of the snake on demand, allowing a more stable platform for inspection, load-inducing operations, and more secure stowage with no moving parts. We will illustrate these and other techniques, such as inflatable extending snake-like structures, with endoscopes and simplified snakes we have tested in our lab.

Background: Dr. Ron Pelrine is Chief Scientist in SRI International's Robotics Laboratory. He has worked in robotics and related fields since 1986 and became an SRI Fellow in 2007. Dr. Pelrine has helped develop numerous robotic devices including pipeline inspection robots using novel magnetic wheels, wall climbing robots using electroadhesion, and levitated micro robots. He is a principal inventor of dielectric elastomers, an electroactive polymer (EAP) technology recently commercialized in consumer products. His chief interests in robotics has been novel mobility technologies ranging from magnetic wheels to electrostatic gripping (wall climbing) to levitation. Other interests include actuators, sensors, and energy harvesting. Dr. Pelrine currently has over 80 patents.

1982-1984: Shell Oil Company - Geophysicist
1989-Present – SRI International

Education: 1979 - BS Physics, MIT
1981 - MS Physics, University of Washington (Seattle)
1988 – Ph.D. Mechanical Engineering, University of Texas (Austin)

Session 4C Presentation 4
"Remote Visual Inspections- Applications and Solutions"
Demo: No Poster: No
One-on-One Table: Yes

Joshua Scott
GE Inspection Technologies
Engineer Manager
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(315) 554-2107

Abstract: The definition of remote visual inspection is derived first from an indirect examination as compared to a direct examination. Direct exam is performed without tools, mirrors or cameras. When direct exam is not possible due to physical or environmental conditions, we must use indirect examination methods.

Indirect exam equipment uses cameras, optics, and display systems to provide video and still images of internal spaces. Today in many cases this is accomplished by video borescopes. Video borescopes allow inspectors to determine the condition of an asset either with qualitative or quantitative methods.

Many applications can be handled with the traditional video borescope with its current technologies for delivery and inspection. However there are other applications, where due to the insertion path into the asset, it is difficult to position the camera. In these cases the inspection either takes longer then desired or it cannot be achieved. This is where further technologies in delivery devices are desired.

Background: Joshua Scott is an engineering manager for GE RVI (remote vision inspections). Over the last 12 years, he has played an active role in product definition and design of the video borescopes product lines. These products have led the industry in quality and performance

Session 5 Presentation 1	**Jim Buttrick**
"Aircraft Assembly Technology Overview"	**Boeing Research &**
Demo: No Poster: No	**Assembly Technology**
One-on-One Table: No	**Automated Machine Development**

Abstract: An overview of Commercial Aircraft Assembly and technology needs. Interested in reviewing technology developed for space that could apply to aircraft manufacturing.

Background: Jim is a Technical Fellow for Boeing Research and Technology, focused on aircraft assembly technology and automated machine development. In his 27 years at Boeing, Jim has primarily worked on the development of wing and fuselage automated assembly systems, focusing on subscale assembly of component parts like spars and wing panels and large scale assembly wing and fuselage structures. In addition, he has worked on the development of composite laminating technology. For the past 16 years, Jim has been instrumental in the development of portable assembly machines for joining large aircraft structure.

1985-Present: Boeing Research & Technology (formerly BCA MR&D)
1979-1983 – Maritime Industry, Licensed Marine Engineer, Ship building

Education: 1979 - BS Marine Engineering, US Merchant Marine Academy
1984 - MS Mechanical Engineering, University of Washington

Session 5 Presentation 2
Surgical NDE and Backscatter X-ray for Aircraft
Demo: No Poster: No
One-on-One Table: No

Dr. Gary Georgeson
NDE Technical Fellow
Boeing Research & Technology
gary.e.georgeson@boeing.com
(206)662-3847

Abstract: Aircraft structures are complex systems that often require Nondestructive Inspection/Evaluation (NDI/E) personnel to remove systems and hardware to perform the actual inspection. Even partial structural disassembly to gain access can result in significant down-time and labor, and potentially introduce additional damage costs. In order to meet the inspection access challenges, surgical NDE tools are needed for increased accessibility for the inspection of these areas within aircraft structures.

NDE methods that can be used from the outside of a structure are also needed. Scatter x-ray imaging (SXI) is a real time, digital, x-ray backscatter imaging technique that allows radiographs to be taken from one side of an object. This x-ray backscatter imaging technique offers many advantages over conventional transmission radiography that include single-sided access and extremely low radiation fields compared to conventional open source industrial radiography. Examples of some applications include the detection of corrosion, foreign object debris, water intrusion, cracking, impact damage and leak detection in a variety of material such as aluminum, composites, honeycomb structures, and titanium.

Background: Dr. Gary Georgeson is a Technical Fellow for Boeing Research & Technology in Non-Destructive Evaluation. He has a PhD in Materials Science from the University of California at Santa Barbara, and has worked for Boeing in Seattle for 23 years. Gary is also the NDE Organization Focal for Contract R&D and Intellectual Property. He established the Advanced NDE Group and associated lab in 2006, which focuses on in-service aerospace NDE development and support.

Gary is recognized for developing innovative NDE methods for evaluating composite and metal aerospace structures. He has published or presented over 120 technical articles in NDE. He has 75 patents, with over 50 patents pending, including innovations such as Quantum Dots for Corrosion Monitoring, the Local Positioning System for maintenance operations, and Backscatter X-ray methods applied to aircraft inspection.

Work Experience:
2005 – Present: Boeing, NDE Technical Fellow; In-Service NDE
1988-2005: Boeing, NDE Engineer
1985-1988: UCSB, Post-Doctoral Researcher, Materials Science

Education:
Ph.D., 1985, Materials Science, University of California at Santa Barbara
B.S., 1981, M.S., 1982, Mechanical Engineering, UCSB
M.A., 1991, Theology, Fuller Theological Seminary

Session 5 Presentation 3
"Overview of USAF NDE R&D Activities"
Demo: No Poster: No
One-on-One Table: Yes

Dr. Stephan M. Russ
Chief, Nondestructive Evaluation Branch
Air Force Research Laboratory
Stephan.Russ@wpafb.af.mil
(937) 255-9803

Abstract: the USAF Aircraft and Propulsion Structural Integrity Programs (ASIP and PSIP) establish requirements and processes to ensure safety of flight. They are unique in that both dictate a 'damage tolerance' approach to life management of key structures/components, relying on predicting and detecting damage (e.g. fatigue cracks). Nondestructive inspection (NDI) is used every day during field- and depot-level maintenance as critical components of ASIP and PSIP and is often the first choice to mitigate risk. As USAF weapon systems age there has been an ensuing increase in both the number and frequency of inspections. Hence, there is a need for better capability, reliability, and efficiency to reduce the maintenance burden and enhance availability of USAF aircraft. Near-term R&D emphasis areas addressing these will be discussed. In the longer term there is a desire to move away from time-based toward condition-based maintenance. This requires increased fidelity in the information from NDE/I such that material and damage state can be assessed sufficiently to enable increased accuracy in predicting future state. NDE research topics/emphasis will be briefly discussed that enable characterization of both material and damage state.

Background: Stephan M. Russ has been Chief of the Nondestructive Evaluation Branch, Materials and Manufacturing Directorate of the Air Force Research Laboratory since March 2010. In this role he is responsible for the supervision of the government workforce, the strategic direction of the branch, and execution of financial resources. Prior to this assignment he was the AFRL Liaison to the AF Fleet Viability Board where his primary contribution was assessing the viability of the airframe structures of both the E-8C and T-38. He has degrees in Mechanical Engineering from the University of Dayton and a PhD in Materials Science and Engineering from the Georgia Institute of Technology. His formative years were spent as a member of the Metals Branch, where he started in the Mechanical Behavior and Life Prediction Group and departed as Chief of Metals Development Section. His technical background is in fatigue, fatigue crack growth, and life prediction of turbine engine materials, and his PhD research was in load-interaction effects on Ti-17. He was instrumental in the formulation and initiation of both the Engine Rotor Life Extension (ERLE) program in the late 1990's and the DARPA Engine System Prognosis (ESP) program in the 2000-2005 timeframe. Both of these programs focused on defining, developing, and implementing S&T to impact sustainment of turbine engines.

2010-Present: AFRL/RXLP, NDE Branch
2008-2010: Air Force Fleet Viability Board
1985-2008: AFRL/RXLM, Metals Branch

Education: 2003 – PhD, Materials Science & Engineering, GeorgiaTech
1991 – MS, Mechanical Engineering, University of Dayton

Session 5 Presentation 4
"Inflatable Habitat Inspection Needs"
Demo: No Poster: No
One-on-One Table: No

Gerard D. Valle
NASA/Johnson Space Center
Structural Engineering Division
gerard.d.valle@nasa.gov
(281)483-8835

Abstract: Space Inflatable offer mass and volume advantages over conventional space structures but also pose additional risks and uncertainties. Understanding deployment dynamics, impact detection, inspection methods, and on-orbit health monitoring are a key interest. Developing reliable, low power, cost efficient measurement systems are especially important for inflatable space structures. This topic will give a brief overview of expandable space structures and discuss the needs with respect to inspection and health monitoring.

Background: Mr. Gerard Valle has worked as a structural engineer for the past 23-years on various project as Pole Crew Escape System, Light Weight Seats, X-38, TransHab, and has managed multiple inflatable technology development projects including the Antarctica inflatable habitat, Damage Tolerance Test Article, Thin Red Line Burst Test, Phase I and Phase II Pressurization test, and other inflatable structure technology development projects. Gerard was the Project Engineer Manager for the Human Research Facility during the launch of HRF-2 on STS 114. Gerard is one of the patent holders for Inflatable Vessel & Methods (US 6,547,189), is a co-author for an AIAA book on Gossamer Spacecraft (Chapter 21), and has authored multiple papers on inflatable structures.

Work Experience:

1989-Present: NASA – Structural Engineering Division
1999-2010 – Biomedical Systems Division and the Systems Architecture and Systems Integration Office
1988-1999 – Structures and Mechanics Division

Education:

1988 - BS Aerospace Engineering, Texas A&M University
2010 - ME Space Systems Engineering, Stevens Institute of Technology

Session 6 Presentation 1
"Composite Pressure Vessel/Rocket Propulsion Inspections"
Demo: No Poster: Yes
One-on-One Table: Yes, NDE and VHM Planning & Partnering

Regor L. Saulsberry
NASA/JSC White Sands Test Facility
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(575) 635-7970

Abstract: Nondestructive evaluation (NDE) and enhanced endoscopic tools are needed for inspection of current and future NASA spacecraft systems to ensure and enhance safe utilization. However, the associated structures and propulsion system components often create extensive inspection challenges. Techniques are needed both during manufacture and in-service. Components of concern include: composite overwrapped pressure vessels (COPVs), engines (including acoustic cavities injectors, cooling cavities and interface lines) and other system components (including fuel flow liners, regulators, and valves). These components and structures are often not designed with inspectability in mind, so specialized techniques and equipment are required to inspect otherwise inaccessible areas of interest. With life extension of the International Space Station beyond its original design, there is also present and growing need for these inspection techniques (on the interior and exterior).

COPVs are often considered especially high risk components, due to significant energy storage and vulnerabilities. Therefore, it is desirable to apply additional NDE during manufacturing to decrease variability and reduce risk and to ensure impacts have not occurred that would compromise the vessels in service. Further, COPVs used in NASA vehicles need monitoring to protect the crew and spacecraft during long term applications where "stress rupture" may be an issue. To help meet these needs and ensure vessels are both manufactured well and applied safely, NASA has initiated a Profilometry/ Multipurpose COPV Scanner and "Smart COPV" programs. Additionally, where vessels have been in service past their original certified life, strategies are needed to ensure their continued safe usage.

Background: Mr. Regor L. Saulsberry is a senior project manager and registered Professional Engineer at NASA-White Sands Test Facility (WSTF). He has 34 years of multi-discipline experience with testing and analysis of Spacecraft systems, components, and materials in which NDE and heath assessment have been major focus areas. He played a key role in development and qualification of the Space Shuttle Orbiter Reaction Control Subsystem and Orbital Maneuvering System for manned spaceflight while with Rockwell International, starting in early 1977. He then developed specialized testing instrumentation and control systems for Lockheed Engineering and Sciences Co. He has since been with NASA Materials and Components Laboratories and Propulsion Offices at WSTF from 1987 to the present. Saulsberry played a significant role in both Shuttle "Return to Flight" efforts and has successfully managed many specialized NDE development projects. He has also led many component failure investigations and propulsion component redesign projects and leads several agency wide technical assessments for the NASA Engineering and Safety Center. Recent accomplishments have included research and development in composite pressure vessel and associated NDE and structural health monitoring, resulting in several new capabilities. He has produced approximately 75 papers, handbooks, standards, and other technical publications.

Session 6 Presentation 2
"Deepwater Sensing for Oil and Gas Applications"
Demo: No Poster: No
One-on-One Table: No

David Brower
President, Astro Technology Inc.
dbrower@astrotechnology.com
(281) 464-9992

Abstract: Recent advancements in sensing methods have been developed and implemented by Astro Technology in deepwater fields that produce oil and gas at depths of 7,500 feet and pipeline lengths of up to 60 miles from the sensors to the offshore platforms. These measurement system are in real time and include temperature, pressure, stress, strain, vibration, and fatigue. The measurements include local and distributed methods in a manner where the entire flow line and riser can be fully characterized at pressures in excess of 3,500psi and extreme water depths.

Additionally, Astro Technology engineers have devised and implemented high temperature measurement methods that allows for temperature and pressure on the interior of a solid rocket motor. In this case the sensors were exposed to a flame temperature of several thousand degrees Centigrade during the operation of subscale and a full scale rocket motor test.

Other harsh environment measurement systems include cryogenic applications and the vacuum of space. Astro Technology sensing systems include extreme temperatures, pressures and chemically harsh environments.

Background: Founded Astro Technology, a high technology firm specializing in new innovative sensor application methods and high-end data acquisition systems. Directed technical efforts to develop and commercialize new fiber-optic sensor systems used for deepwater oil production equipment, liquefied natural gas pipelines, solid rocket motors, and civil engineering structures. Developed a complete advanced structural monitoring system with fiber optic sensors in deepwater fields of the Gulf of Mexico. Developed advanced flow assurance monitoring methods on 60 mile long Subsea flowline. Led hazards analysis work for the elimination of weapons of mass destruction in Russia in support of strategic arms limitation treaties between the U.S. and Former Soviet Union. Formed Clear Gulf Joint Industry Project as a collaboration between NASA and oil and gas companies. This effort has contributed to making deepwater oil production safer and environmentally responsible. The JIP has formed a synergistic relationship between two industries where both parties are benefiting greatly.

University of Utah, B.S., Material Science & Engineering

Session 6 Presentation 3 **Rick Russell**
"Spacecraft Pre-launch/Turnaround NDE needs at the Kennedy Space Center"
NASA/Kennedy Space Center
Materials & Processes Engineer
richard.w.russell@nasa.gov
(321) 266-4856
Demo: No Poster: No
One-on-One Table: Yes

Presentation: Mr. Rick Russell will be giving a presentation titled "Spacecraft Pre-launch Turnaround NDE needs at the Kennedy Space Center".

Background: Rick Russell is a senior Materials and Processes Engineer in the Materials Science Division at the Kennedy Space Center. Rick is the lead of the Specialty Engineering (Materials and Processes and Fracture Control) team for the Commercial Crew Program. He is also the KSC representative for the NASA NDE Working Group (NNWG) and a member of the NESC Materials and NDE Technical Discipline Teams. Rick is currently the principle investigator on an NNWG funded research project developing eddy current Magnetic Stress gages for the health monitoring of Composite Overwrapped Pressure Vessels.

Previous to his current position Rick served as the Aging Aircraft Principal Engineer for the Orbiter Project Support Office at the Kennedy Space Center. In this position he was responsible for providing assistance to the Orbiter Project Office in managing aging Orbiter issues such as corrosion, nondestructive evaluation, non-metallics, wiring and subsystems. Rick served as chairman of the Orbiter Corrosion Control Review Board and of the Aging Orbiter Working Group.

Mr. Russell began his career in 1986 at the Naval Aviation Depot in Pensacola, Florida. In 1989 he then joined NASA's Kennedy Space Center serving as a Materials and Processes (M&P) Engineering expert within the Shuttle Engineering Project Office. In 1996, Mr. Russell left NASA and worked in aircraft manufacturing and design at The Aerostructures Corporation in Nashville Tennessee and Bell Helicopter in Ft. Worth Texas. In 2001 Mr. Russell rejoined the Shuttle program working for the United Space Alliance at Kennedy Space Center serving as lead of the ground operations M&P Engineering Group, a position he held until rejoining NASA in 2004.

Rick has a B.S. Degree in Metallurgical Engineering from the University of Illinois (1984) and a M.S. Degree from the University of Florida in Materials and Science and Engineering (1986).

Session 6 Presentation 4
"Satellite Servicing Mission"
Demo: No Poster: No
One-on-One Table: Yes

Benjamin Reed
NASA GSFC
Deputy Project Manage SSCO
Benjamin.b.reed@nasa.gov
(301)286-4755

Abstract: In the past two decades, some of the most extraordinary successes in space exploration have emphasized the growing importance of on-orbit servicing. As space explorers, our challenges have moved beyond simply launching complex spacecraft and systems. We are faced with the need to more fully exploit the flight systems already launched, to construct large structures in situ to enable new scientific ventures, and to provide systems that reliably and cost-effectively support the next steps in space exploration. The proliferation of abandoned satellites poses known hazards to newer members of the constellation, and may occupy unique and economically valuable orbital real estate that could be recycled for other uses. With the successful completion of a series of Hubble Space Telescope repairs, as well as the assembly of the International Space Station, we can look forward with confidence to plan such a future. Satellite servicing is a tool—a tool that can serve as the "master enabler" to create the architectures needed to conquer the next frontiers in space. An snapshot of the current programmatic and technological status of robotic satellite servicing will be given with emphasis on the needs for NDE.

Background: Mr. Benjamin Reed serves as the Deputy Project Manager of the Satellite Servicing Capabilities Office (SSCO), located at NASA's Goddard Space Flight Center in Greenbelt, Maryland. In this role, he is responsible for all technical and programmatic aspects of the Project.

As a guiding member of the 2010 NASA Goddard Servicing Study, he played a lead role in investigating what the benefits, challenges and roadmap of satellite servicing. He was also a member of the joint *NASA/DARPA Manned GEO Study*. He also serves as the Deputy Chair of the *Active Debris Removal Study* for the NASA Office of the Chief Technologist and served as a member on the Robotics, Tele-Robotics, and Autonomous Systems team on the *NASA Space Technology Roadmaps and Priorities* for the National Research Council .

Previously, Mr. Reed gained 11 years of experience as the Lead Materials System Engineer for the Hubble missions STS-95, -103, -109, and -125, as well as the Goddard portions of STS-114, -118, -123 and -126. For this work he has earned several project, Center and Agency awards. He is most proud of earning a Silver Snoopy.

As an Agency-wide expert on space environmental effects on materials, Mr. Reed lead a multicenter team of engineers and scientists in analyzing and predicting the condition of space-exposed material. This work proved instrumental to the planning and execution of 13 successful extravehicular activities and the continued successful operation of the Hubble Space Telescope.

Session: Lunch, March 1st
"Automotive Manufacturing NDE Inspection Techniques"
Demo: No   Poster: No
One-on-One Table: Yes

Dr. Leonid Lev
GM R&D
Chairman, US CAR NDE Working Group
leo.lev@gm.com
(586) 807-2230

Abstract: Automotive manufacturers are gearing up to meet new fuel economy standards. Among the enabling technologies are hybridization of the automotive powertrain and lightweighting of the vehicle.

The battery is a critical part of a hybrid powertrain. Recently, GM started production of PHEV Chevy Volt and its batteries. I will discuss NDE methods developed in support of this activity. The existing methods of nondestructive control were modified and the new ones developed to satisfy high quality requirements for Li-ion batteries. Examples of the newly developed technologies will be presented.

Lightweighting of the vehicle is accomplished by the wide use of composite materials, magnesium, high-strength steels. The problems presented by the use of these materials and by joining dissimilar materials will be presented. Future automotive NDE needs and requirements will be discussed.

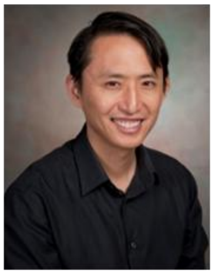
Background: Dr. Leonid C. Lev received his Engineer degree from Kiev Polytechnic University, (Kiev, Ukraine) and St. Petersburg Polytechnic University, (St. Petersburg, Russia, both former Soviet Union) and his PhD in Mechanics of Materials from MIT under Prof. A. Argon. Dr. Lev has been with GM R&D since 1995, working on variety of material behavior and production issues, recently leading the NDE development.

Session: One on one with end users
Research and Education opportunities at CNDE
Research and Education Opportunities at ISU
(515) 294-5227

Lisa Brasche
Associate Director
Center for Nondestructive Evaluation, ISU
lbrasche@cnde.iastate.edu

Abstract: The ***Center for Nondestructive Evaluation (CNDE)*** was established at Iowa State University in 1985 as a ***NSF Industry/University Cooperative Research Center***. NDE plays an important role in safe use of engineered systems ranging from offshore oil facilities miles below the sea, to bridges and roadways we use every day, to planes that carry both the public and defense personnel. CNDE has a long history of working with industry to provide cost-effective tools and solutions which address relevant problems for a variety of industrial sectors which include: ***Aerospace*** (commercial and military aviation) ***and Defense Systems*** (ground vehicles and personnel protection); ***Energy*** (nuclear, wind, fossil); ***Infrastructure and Transportation*** (bridges, roadways, dams, levees); and ***Petro-Chemical*** (offshore, processing, fuel transport piping). Industrial partnerships with nearly 100 companies have included the NSF IUCRC program, single-company proprietary projects, multi-company collaborations, and CNDE-led consortia. With over 30 scientists and engineers, CNDE is the premier US research organization for the development and application of inspection and sensing technologies. Among many accomplishments is development and commercialization of ***simulation models*** for the three major inspection modalities, eddy current (ECSIM), ultrasonics (UTSIM), and radiography (XRSIM), which are used in inspection optimization, detectability studies and training. Additionally, extensive ***materials characterization studies*** and ***inspection system developments*** have been applied and implemented for metals, ceramics, and composites from several industrial sectors. Experimental and theoretical capabilities exist for the full range of inspection methods, housed in a 52,000 sq. ft. facility with over $6M in state-of-the-art research instrumentation that includes electromagnetics, radiography, thermal, terahertz, and ultrasonics. A growing ***NDE education program*** is in place which includes an undergraduate NDE Minor and a graduate certificate which is available as a distance education option. Iowa State is the only US institution to offer an NDE minor at the undergraduate level with 20 to 30 students typically in the program. In 2011, a graduate level certificate in NDE became available thru on-line learning, also a first in the nation offering. CNDE also has a number of specific training developments including programs for FAA Aviation Safety Inspectors and Certification Engineers and materials for use internally at companies. A short course is offered annually to IUCRC sponsor as part of their membership. A major accomplishment of the CNDE programs is the NDT Resource Center, the NDE website used by over 300,000 users per month. Through this website, new educational materials with high quality graphics and interactive content have been made available to the NDT community. To raise awareness of NDT as a career field, science-based educational materials and career information were also developed for junior and senior high school students. With details at www.ndt-ed.org, the site is recognized as the resource for students, technicians and engineers.

Background: Lisa Brasche is Associate Director for the Center for Nondestructive Evaluation and Program Manager for FAA, AF, Army, NASA, and industry funded programs at Iowa State University. Responsible for facilitating research collaborations with industry and government on behalf of the CNDE and the ISU Wind Energy Initiative, she received a M.S. in Metallurgy from ISU in 1987 and a B.S. in Materials Science and Engineering from North Carolina State University in 1984. Brasche has authored over 30 publications and holds one patent. Brasche has served on the ASNT Board of Directors (2010 – 2012) and the Iowa Wind Energy Association Board of Directors (2010 – 2014).



Patrick Chan
NASA (S3C-P5)

Lou Wainwright
American S&E (S4A-P1)

Daniel Shedlock
Nucsafe (S4A-P2)

Victor Grubsky
Physical Optics (S4A-P3)

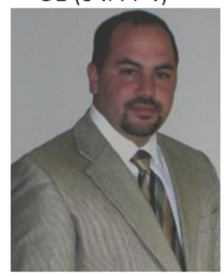
Rebecca Rudolph
GE (S4A-P4)

Steven Frederickson
NASA (S4B-P1)

Mark Micire
NASA (S4B-P2)

Dave Hinkley
Aerospace Corp (S4B-P3)

Rob Buckingham
OCRobotics (S4C-P1)



Frank Lefleur
Olympus (S4C-P2)

Joshua Scott
GE (Lunch)

Jim Buttrick
Boeing (S5-P1)

Gary Georgeson
Boeing (S5-P2)

Stephan Russ
AFRL (S5-P3)

Gerard Valle
NASA (S5-P4)

Regor Saulsberry
NASA (S6-P1)

Dave Brower
Astrotechnology (S6-P2)

Rick Russell
NASA (S6-P3)

Ben Reed
NASA GSFC (S6-P4)

Leo Lev
GM R&D (Lunch)

Lisa Brasche
ISU/CNDE (Forward Planning)

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