Media Briefing: New Technology Could Aid in Interpretation of Medical Imagery

NASA hosted a media teleconference at 11 a.m. ET on Thursday, Oct. 14, 2010, to discuss NASA software that has been incorporated into a new medical imaging technology that one day could aid in the interpretation of mammograms, ultrasounds, and other medical imagery.

NASA hosted this event in conjunction with Breast Cancer Awareness Month.

Below is a transcript of the media telecom provided for informational purposes. No guarantee is made as to its complete accuracy.

Coordinator: Welcome and thank you for standing by. At this time all participants are in a listen only mode until the question and answer session of today's conference. At that time you may press star 1 if you'd like to ask a question. I'd like to inform all parties this call is being recorded.

If you have any objections, you can disconnect at this time. I would now like to turn the call over to Ms. Rani Gran, Public Affairs Officer of NASA Goddard Space Flight Center. You may begin ma'am.

Rani Gran: Good morning. Again my name is Rani Gran. I'm the NASA Goddard Space Flight Center Public Affairs Officer. And I want to thank everybody for joining us today. A couple of business notes - we are in the process of publishing the media and press release to www.NASA.gov/Goddard.

But technology is being slow this morning so we'll say it's a delayed reaction by www.NASA.gov. But they will be there and some - there will be corresponding images and video that can be downloaded in HD, standard def, multiple formats for everybody for the conference.

Again today we are here to talk about NASA software that was originally designed to support earth science imagery and is now being applied to medical imagery devices. We have a great panel this morning. First I'm going to introduce them.

Nona Cheeks who is our Chief of NASA Goddard Space Flight Center Innovative Partnerships Program Office. Dr. James C. Tilton, PhD, he's a computer engineer at NASA Goddard Space Flight Center. Fitz Walker, President and CEO of Bartron Medical Imaging.

And Dr. Molly Brewer who is a real MD doctor, a professor with the Division of Gynecology Oncology, University of Connecticut Health Center. So now I'd like to start off and hand it over to Nona.

Nona Cheeks: Thank you and good morning Rani and good morning to all that are participating in this teleconference. I'd like to begin by saying that the agency has always had a responsibility to disseminate information about its scientific and technical findings.

And the purpose of us doing so is to make the public and private sector aware of NASA's technical capabilities.

The benefit of doing so allows us to share what our achievements have been and allows us to be able to have industry use or have access to the use of NASA technology beyond its original intent within the agency and external to the agency.

The goal of this is to make the public and private sector aware and allow them to be involved in terms of moving the state of the art of the technology towards new products, new techniques, etc.

We are proud of the fact that our scientific and technical findings have advanced or enhanced new commercial products that benefit mankind. Many have been in the medical device field.

This being Breast Cancer Awareness Month has me reflect on how our NASA Space Science Hubbell Repair Mission of the 1990s use of the charge couple devices or UV detectors were also applied to instruments, sensors for mammogram or mammography equipment.

In early 2000 NASA Goddard hosted an outreach meeting about imaging technology that could be applied to the medical imaging applications.

It was a one day workshop that included many papers given by NASA scientists and engineers regarding their work at NASA Goddard and the potential of their technology for use outside of NASA.

One of the researchers participating in this workshop was Dr. Jim Tilton of our Earth Science Division. Following his presentation we had many discussions and a lot of the discussions centered around the potential applications and license of the technology.

A license was then granted to a company that also included a cooperative research partnership agreement. And the intent there was to further the development of the technology for commercial use. And with that said I'd like to hand it over to...

Rani Gran: Sorry. This is Rani Gran, PAO. We have a shortcut link for everybody to get onto this site and follow Jim because I know he has a number of visuals with his talk. It's HTTP://go.usa.gov/aWX.

James Tilton: Do you want to give that...

Rani Gran: One more time. HTTP://go.usa.gov/aWX. And I'm sorry, Jim take it over from here.

James Tilton: Okay, well thank you Rani and thank you Nona and welcome everybody to the teleconference here. It's well mentioned that Nona's office has been quite helpful in making HSEG widely known throughout the earth science research community as well as the commercialization efforts.

Dozens of earth scientists worldwide have experimented with using the HSEG software package in support of their research activities.

Now even though I originally developed HSEG with the goal of supporting earth science applications we are witnessing here today that the first commercial application of HSEG is in the medical arena. But just what is HSEG?

To explain this I need to first explain how images are processed by computers. Images must be represented by numbers in order to be processed by computers. Today's digital cameras automatically create and store images in the form of numbers.

But images that are originally captured on film must be first electronically scanned and digitized into numbers before they can be processed by a computer. Each number making up a digital image represents the gray scale value or a color component value for a particular location.

For images of the earth the spatial location may be anything from say, a one meter square area to perhaps a one kilometer square area depending upon the satellite based instrument collecting the image.

The digital value that's associated with each spatial location of an image are commonly called the picture elements or pixels for short. The most common approach for analyzing such remotely sensed earth images is to have the computer program interpret each image pixel individually.

While this approach can often give useful results this approach does not fully exploit the computer's capabilities. I developed HSEG, the hierarchical segmentation software package to help enable moving from analyzing images one pixel at a time to analyzing images in terms of region objects.

Representing the image in terms of region objects instead of pixels gives a computer much more information to use in interpreting the image. While image pixels are essentially single points the image region objects are in shape and size pattern relationships with other region objects.

Information a computer can use to more completely and accurately interpret an image. Now while there are many different approaches to finding region objects and images, HSEG is unique in its approach to doing this in the following three ways.

First HSEG not only finds region objects but also groups basically separated region objects into region classes. Second, HSEG automatically performs this grouping at varying levels of detail or hierarchical levels.

And third, the region object boundaries are maintained at the full spatial resolution of the original image for all hierarchical levels of segmentation detail. What this all means can be made clear by looking at an example using HSEG to process an earth satellite image.

And I hope you've got the Web page up there with the images on there. There are some figures on there I want - I hope that you can all look at. Figure 1-A there is a Landsat Thematic Mapper image from over the lakes region of Northern Wisconsin.

In this image lakes appear in different shades of blue. In processing this image with HSEG, HSEG first finds each individual lake and then it groups together all of the lighter blue lakes into one class and the darker blue lakes into another at one hierarchical level.

You can see a depiction of this in Figure 1-B where I have the lighter blue lakes colored very light blue and the darker blue lakes colored a dark blue. And other ground cover such as vegetation and bare soil and other things are colored with different colors in the image.

Now HSEG continues the process along to a coarser hierarchical level. And at the end it comes up with a two region class result that you see in Figure 1-C.

Here all of the lakes are grouped together in one class and everything else is grouped together in another as depicted by the blue and brown colorations of that image.

Rani Gran: And Jim...

James Tilton: Yes?

Rani Gran: ...I'm going to interrupt you one more time just to give the URL to the reporters again. It's HTTP://go.usa.gov/aWX.

James Tilton: Okay. Very good. I hope you all have that. I just want to continue here and note that my original motivation for doing this type of region classification along with region object finding was to provide a compact high quality computer interpretable description of an image that could be used for object base image analysis to support earth science studies.

However, Bartron's MedSeg device doesn't use HSEG in this way. Now after listening to a presentation I made about HSEG at the NASA Technology Transfer Conference some eight to ten years ago, Fitz Walker of Bartron realized that HSEG's compact region class description of an image could also be used to provide a highly optimized mapping of the image data for visualization.

This is the basic premise of the MedSeg device. Now initially I was actually skeptical that the visualization mapping provided by HSEG could be any much better than any other well established image enhancement technique.

So I was quite surprised when I later had the chance to independently analyze the cell images provided to me by Alden Dima of the National Institute of Standards and Technology. You see Figure 2 for example, of one of those cell images.

In Figure 2-A you can see the unprocessed cell image displayed normally. Applying a standard image enhancement technique called a histogram equalization produces the result you see in Figure 2-B. The problem with this approach is that it has no way to distinguish what's background in which cell.

And so what we end up doing is enhancing the background more than it does the cell itself and actually the cell is nearly washed out in this image here. The result of applying HSEG to the data gives the result in Figure 2-C.

Here you see - because HSEG does use spatial information and can distinguish background from the cell itself, it can figure out in its processing that there is more interesting activity going on in the cell and ends up enhancing the internal areas of the cell more than it does the background.

And here you can see a lot more details inside the cell brought out by the HSEG processing. Now to be quite frank with all of you we actually could get a visualization very much like this with other means, even using something like Photoshop I suppose.

But you'd have to play around with clipping and contrast stretching and so on and this could be quite an interactive, involved process to do that and it's quite tedious to do for every single image individually.

But with HSEG all you have to tell HSEG is to process the image to 256 regions which is the number of gray scale normally displayed in an image.

And to then display that in region labels in order from the darkest to the brightest region and it comes out exactly like this. They can do that consistently, automatically, all the time.

So upon seeing results like this I became convinced that Bartron really was onto something and I was really quite surprised that something that I developed for a large scale earth science image study could also be applied so effectively on such a small scale.

Now actually my experience with the Bartron MedSeg application has actually fed back to help with an earth science study.

Over the past couple of years I've had the opportunity to work with an archaeologist on a project seeking to find potential human settlement sites from remotely sent images obtained from aircraft and satellite based sensors.

The archaeologist had previously devised a statistically based scheme for identifying anomalies in vegetative growth caused by changes in the underlying soil from human activity perhaps 1000 years earlier.

As it turned out the statistical technique depended upon having the image data quantized into a finite number of gray scale levels. I quickly realized that this problem was very similar to the visualization mapping problem that HSEG itself or Bartron's MedSeg device and successfully used HSEG to find image data quantizations for the archaeologist analysis procedure.

So in summary I originally developed HSEG to improve earth scientists' capability to extract desired information from images collected by earth orbiting satellites.

And HSEG does this by combining defining region objects with region object classification at various levels of detail by creating a segmentation hierarchy thus the name hierarchical segmentation.

At all levels of the segmentation hierarchy the region boundaries are maintained at the original image spatial resolution.

While I did indeed develop the underlying HSEG technology the MedSeg product would have never come about without the unique insight that came to Fitz Walker at that NASA Technology Transfer conference some eight years ago.

So Fitz, I'll turn it over to you to explain how you took that insight and developed it into Bartron's MedSeg product.

Fitz Walker: Thanks Jim. When I saw Dr. Tilton's software I started to wonder if it could be used for medical imaging. And I began to think harder and said okay, let's license the software. So we licensed the software in 2002. We began to rewrite the algorithm HSEG to apply to medical imaging.

So out of that came a motto, "From outer space to inner space." We moved - we were developing this within our garage. And after four years building a Beowulf cluster to run the HSEG algorithm on we moved out into Yale at Science Park.

And after years validating and verifying the software with images, we went to the FDA for 510-K clearance.

And we're happy to announce that the past July 2010 the MedSeg received FDA clearance allowing Bartron to market the device subject to the general controls and provisions of the Federal Food and Drug and Cosmetic Act. So what does this mean? The MedSeg is a trademark.

It's a software device that receives medical images, data from various imaging sources, compute and direct radiology devices, secondary devices. Images can be stored, communicated, processed, displayed within the system across the computer network and distributed locations.

All of this results in an enhanced image that provides more data to the clinical user. The clinician can be a physician, radiologist, nurse, medical technician or other type trained professionals.

So the MedSeg uses images from various imaging sources such as MRIs, CT scans, X-rays, ultrasounds and mammograms. So you can separate 2-D images into digital related sections or regions after colorization. And it can be used individually labeled by the user.

The system incorporates the (parallel) algorithm RHSEG that performs high speed segmentation and regionization. As you can see in the images the original image just shows you what the radiologist and the doctor would get.

And then if you look at the bottom you will see the segmented image that is produced by the MedSeg and what's labeled. So out of this came a goal in the company that mission is to develop a medical device that makes a difference and saves lives.

Now I'd like to introduce Dr. Molly Brewer and turn it over to her. Molly?

Rani Gran: Molly, you might have to unmute.

Molly Brewer: Yeah? How do I do that?

James Tilton: You just did it.

Fitz Walker: You just did it.

Rani Gran: You're on.

Molly Brewer: Okay, so it's working now?

Fitz Walker: Yes.

Molly Brewer: Great. Okay. I wasn't sure I knew how to unmute. So I started working with Fitz I think it was actually late 2006. And he approached me - I met him shortly after I came to the University of Connecticut.

And I met him through a mutual friend who was actually working using this - using the MedSeg to look at some bone structure in the mouth. And when he showed me the technology, you know, one of the things that we talked about was what the potential applications would be.

And one thing that we kind of decided together was a great approach would be mammography. Part of the problem with mammography is if a women, particularly if a woman has very dense breasts it's very difficult to see through them.

And so having done quite a bit of imaging in terms of my research, one of the things that we start to look at is we start to look at changes in density. And what happens when a radiologist reads a mammogram or a CT scan or an MRI actually, is they look for differences in density.

So that's subject to the human eye which is one of the places that differences can occur, not really errors. But it just - we may not see with our eyes what a computer could see if it was defragmented. And so based on these differences in density I became really interested in this technology.

So one of the things that Fitz and I have done is we've investigated just very early on what can be seen in mammograms. And we've compared cancers to noncancers. And it really looks like once we figure out the algorithm that this may be a technology that would be important.

Now one of the things that always comes up is what is the clinical importance. And for me the clinical importance is I see many patients at risk for breast cancer. And so if the mammogram is not sufficient they go on for an MRI. Well that's actually very costly.

And sometimes insurance companies are now saying we won't pay for that. The other thing that happens with the MRI is that over calls in a woman with dense breasts whereas the mammogram may under call. So I see tremendous potential for this technology.

Rani Gran: All right. Operator, that kind of ends our panelist discussion. I'd like to open it up to people online for questions and answers.

Coordinator: Thank you. We'll now begin the question and answer session. If you'd like to ask a question please press star 1. Please record your name. If you'd like to withdraw a request press star 2. One moment while we wait for the first question.

One moment. Our first caller is from (Jim Bryce) from www.AuntMinnie.com. Your line is open sir.

(Jim Bryce): Yes. I have a question for Fitz Walker. Mr. Walker, does your company have commercial relationships with any of the platform developers and providers such as GE, Siemens, Phillips or others, for the inclusion of your software within their products for data manipulation and image reconstruction?

Fitz Walker: Not at the moment. The MedSeg is a trademarked application that is a system that encompasses - that has both the segmentation and the software/hardware in it. But we are developing synergy with GE and Siemens as an add on device to their tools that they have out.

(Jim Bryce): I see.

Fitz Walker: But you could also say added value to that tool.

(Jim Bryce): I wonder if I - could I pose a question to Dr. (Brewster)?

Molly Brewer: Go ahead.

(Jim Bryce): Dr. (Brewster), have any clinical trials been performed thus far with the software to quantify the improvements in image quality that are seen either quantitatively or qualitatively with panels of radiologists to measure the perceived difference in the images?

Molly Brewer: Actually that's a great question because that's really where we're going with this. Fitz and I are talking about how to start in terms of analyzing this technology for cancer diagnosis or to rule out a cancer diagnosis.

So we're planning clinical trials. That really will be the thing that answers that question.

(Jim Bryce): Does anybody else have some questions?

Coordinator: I have no further questions at this time.

(Jim Bryce): I do.

Coordinator: Go ahead Mr. (Bryce).

(Jim Bryce): Okay. I'm sorry. I wonder if there's any potential for the use in this software for computer aided diagnosis or is that separate?

Fitz Walker: Yes. That's something where we're going. We're looking at screening and then going into diagnosis for - following screening. This will be done with the clinical that me and Molly are talking - setting up that clinical protocol.

Rani Gran: Operator, can you open up the call for any further questions from other reporters?

Coordinator: Yes. Our next question comes from (Gene Ostroski). Your line is open.

(Gene Ostroski): Yes, hi. I'm just looking for any additional more technical information on the technology. Where can I find it?

Rani Gran: We're going to have stuff online at www.NASA.gov. And I'm sorry.

Nona Cheeks: Yeah. You can go to www.NASA.gov or you can also go to NASA's Web site which is www.IPP.NASA.gov. And you can look up the HSEG technology there and you can find more information on its technical...

(Gene Ostroski): That's - what's the - AGG you said?

Nona Cheeks: HSEG for hierarchical segmentation. H as in Harry, S as in Sam, E Edward, G...

(Gene Ostroski): Got it.

Nona Cheeks: But if you go to the URL I just gave you, www.IPP.GSSC.NASA.gov you'll see in the center of the page it gives you highlights on technology and you should be able to find this technology.

(Gene Ostroski): Okay, great. Thank you.

Nona Cheeks: You're welcome.

Coordinator: Once again if you'd like to ask a question or make a comment please dial star 1 and record your name.

Rani Gran: And if there are any further questions in the technical area I know that Dr. Jim Tilton would love to talk about that in more detail. Okay. While we're waiting for questions I had a couple of things I wanted to add. Nona for you what other licenses are availed?

I mean this is just one license for this technology. Is there other licensing that other types of companies could get?

Nona Cheeks: Yeah, sure. Thanks Rani. Yes. There are other areas that we are interested in licensing this technology. And a couple of examples include certainly in the agricultural area when you're looking at vegetation and things of that sort.

Veterinarian applications and one of the key areas that we've been exploring or talking about with Dr. Tilton has to do with complex databases that have images, lots of images or imagery. How do we tackle that? So those are a few of the areas that we are looking to explore.

Rani Gran: And then again when do the clinical trials for the mammography begin? I guess that would be a question for Dr. Brewer or Fitz.

Molly Brewer: Well I think that's one of the things that we're in the process of sorting out. We hope to get some clinical trials up within the next six to eight months.

Rani Gran: And Operator are there any further questions from the reporters out there?

Coordinator: I have no questions at this time.

Rani Gran: Okay. Well all right. I am going to wrap things up here. I want to thank everybody for joining us today on this (telethon). And if you want further information to look at imagery it is now live on www.NASA.gov/Goddard.

Again video for this talk can also be downloaded in multiple formats and there are images as well. So thank you again for joining us.

Coordinator: This concludes today's conference. We thank you for your participation. You may disconnect your lines at this time. Have a great day. One moment leaders.

END