



Information Technology and Software

## Intelliface Autonomous System Simulation Testbed

Develop robust interfaces among planning, execution,  
and diagnosis systems

NASA has developed a novel technology that can develop, integrate, and evaluate intelligent subsystems that comprise an autonomous system. Autonomous systems use planning systems to select, configure, and schedule actions that perform tasks and achieve or maintain certain conditions. Adaptive control systems execute plans using conditional logic to adjust how actions are performed in particular situations. Diagnostic systems define the system state through detection and isolation of faults and other types of problems that can reduce system capabilities and capacities. When these off-nominal problems occur, the autonomous system must adapt to the new system state by generating and executing a new plan, requiring coordination among the planning, execution, and diagnosis subsystems. Developing and maintaining these interfaces by hand is time-consuming and error-prone. This technology developed by NASA is a software design methods and tools which help people develop robust interfaces among planning, execution, and diagnosis subsystems more quickly and consistently.

### BENEFITS

- ➔ Enable more effective development of intelligent autonomous systems that comprise of integrated intelligent subsystems such as planners, adaptive controllers, and diagnostic and prognostic systems
- ➔ Partial automation of model generation makes it possible to create models and interfaces more quickly and reliably
- ➔ Information-dense graphical data displays help experimenters understand more quickly and effectively the states, events, and actions that take place during experimental runs
- ➔ To aid the user, the User Interface shows the current plan in a Gantt chart, and it displays the sensor data and commands in graphs and timelines

technology solution



## THE TECHNOLOGY

The Intelliface software testbed supports the development and evaluation of integrated intelligent software subsystems that comprise an autonomous system. For development the PPIntelliface/ADAPT uses code generation to partially automate the generation of models used by the Planner. It uses the Action Notation Modeling Language (ANML) to encode and exchange planning domain knowledge and problem statements. ANML is an expressive, high level planning language that enables powerful and succinct encoding and exchange of planning problems and domain knowledge. HyDE also is an expressive language define through a interval extension of Reactive Model-Based\_ Programming Language (H-RMPL). For evaluation, at NASA Ames, in the Information Sciences Division (Code TI), the Advanced Diagnosis and Prognostics Testbed (ADAPT) is a electrical distribution hardware testbed which support research in autonomous system architectures in conjunction with advanced crew user interfaces. Intelliface/ADAPT is an application of Intelliface that controls the ADAPT hardware testbed and, in an alternate configuration, a NASA-developed software simulation of ADAPT. It allows for the evaluation of different autonomous system control policies for key subsystems within Intelliface/ADAPT including an automated planning system; an adaptive execution system; a NASA-developed automated diagnosis system that is based on NASA's Hybrid Diagnostic Engine (HyDE); and a user interface that displays plans, sensor data, and commands in information-dense arrays of time-series graphs and timelines to help experimenters see patterns in multivariate time-oriented data. The User Interface also includes a dynamically color-coded schematic of the ADAPT system that shows the diagnostic nominal/off-nominal system state vector of system components and the usage and availability of more abstract ADAPT system resources as modeled by for the Intelliface planner. This technology is based on the insight that all of the autonomous subsystem components are different views of the same system (plant in controls terminology). Hence clean interfaces can be defined by using common descriptors for all the interfaces.

## APPLICATIONS

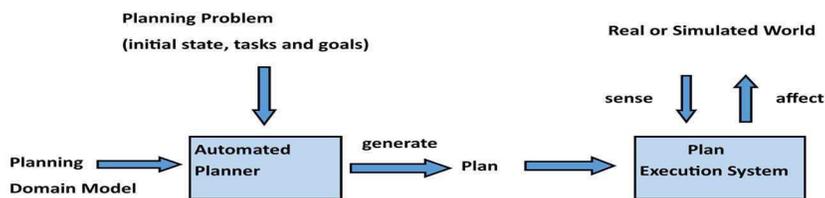
The technology has several potential applications:

- Autonomous space vehicle manufacturing
- Integration of intelligent subsystems
- Unmanned vehicles
- GPS / SPA technologies
- Communication payloads
- Fluid transfer systems

## PUBLICATIONS

Patent Pending

"Software Testbed for Developing and Evaluating Integrated Autonomous Systems"  
Ong, Remolia, Prompt, Robinson, Sweet,  
Nishikawa 2015 IEEE Aerospace



Integration of model-based plan generation and execution

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