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Technology: ATL Scheduling Tool Suite (ASTS)

It's All About Timing

Introduction

In hard real-time systems, processing deadlines must be met or disastrous failures can happen. Systems engineers must design systems to meet timing requirements, and they must demonstrate that deployed systems will not miss processing deadlines. Lockheed Martin Advanced Technology Laboratories (ATL) is providing critical performance engineering support through its ATL Scheduling Tool Suite (ASTS).

The ASTS is a collection of tools for studying the timing performance of fixed-priority, end-to-end systems. The principal tools are a discrete event simulation tool, a mathematical analysis tool, and an automated emulation tool.

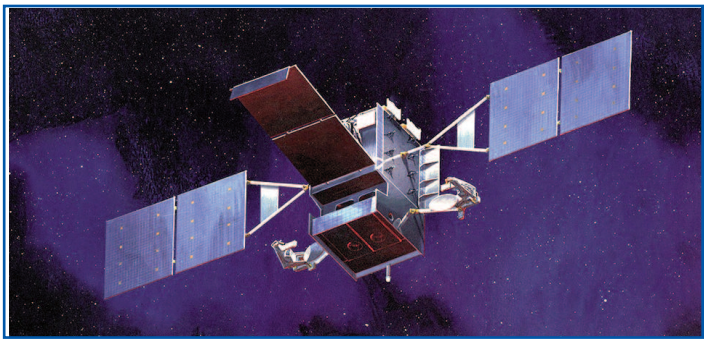
ASTS's tools share a common input format for system definition and offer distinct performance engineering benefits. The discrete event simulator steps through one or more instances of a system's timeline and produces lower bounds on worst-case response times. The mathematical analysis tool runs an algorithm that considers all allowable variations in task release, execution, and synchronization times and generates upper bounds on worst-case response times. Emulation executes simulated workloads on actual distributed hardware with selected operating systems and middleware to examine their adherence to system engineering and modeling assumptions.

ASTS at Work

Recent ASTS applications include modeling Technical Performance Measures (TPM) of the weapon control element (WCE) on the Zumwalt Class Destroyer, flight software system architecture studies on the Space-Based Infrared System (SBIRS), and a real-time data collection chain for automated schedulability analyses on airborne systems like those used on the F-22 and F-35 aircraft.

On the destroyer program, ASTS not only verified that the WCE could meet its real-time performance requirements from engagement orders to launch or firing, but it also identified optimal firing time windows.

The SBIRS Spacecraft Flight Software System was originally hosted on two single-board computers. When synchronization problems arose between the two processors, the software system was redesigned to put all critical applications on a single processor. However, timing measurements showed that some tasks could miss their deadlines, and execution times had to be reduced. Using ASTS, engineers first determined how much streamlining of tasks was needed and then proved that a staggered release of tasks could meet all deadlines without execution time reduction. ASTS timing predictions enabled SBIRS flight software redesign to proceed with assurance of timing performance before system integration, thereby reducing program risk and saving cost and test time.



For SBIRS the ASTS simulation tool was able to show that staggered release of tasks provided an alternative to achieve execution time reduction.

ASTS has Wide Application Potential

ASTS can analyze systems timing requirements and performance issues including:

- The minimum number of processors that can accommodate all system tasks while meeting performance requirements.
- Verification of a distributed system's architecture's ability to meet performance requirements.
- How end-to-end timelines can vary depending on start times and task execution times.
- How much more load can be added, or how much longer certain tasks can execute without causing deadline misses.

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