ognizer is not used. When the grammar-based recognizer fails and the SLM recognizer produces a recognition hypothesis, the SLM output is processed to generate a message that tells the user what was recognized as having been uttered, a diagnosis of what was problematic about the recognized utterance, and a related in-coverage example. The in-coverage example is intended to encourage alignment between the user's utterances and the prescribed language.

This work was done by Gregory Aist and James Hieronymus of the Research Institute for Advanced Computer Science; John Dowding and Beth Ann Hockey of the University of California, Santa Cruz; Manny Rayner of the International Computer Science Institute; Nikos Chatzichrisafis of the University of Geneva; Kim Farrell of QSS; and Jean-Michel Renders of Xerox Research Center Europe for Ames Research Center. Further information is contained in a TSP (see page 1). ARC-14610-1

Injecting Errors for Testing Built-in Test Software

Lyndon B. Johnson Space Center, Houston, Texas

Two algorithms have been conceived to enable automated, thorough testing of Built-in test (BIT) software. The first algorithm applies to BIT routines that define pass/fail criteria based on values of data read from such hardware devices as memories, input ports, or registers. This algorithm simulates effects of errors in a device under test by (1) intercepting data from the device and (2) performing AND operations between the data and the data mask specific to the device. This operation yields values not expected by the BIT routine. This algorithm entails very small, permanent instrumentation of the software under test (SUT) for performing the AND operations.

The second algorithm applies to BIT programs that provide services to users' application programs via commands or callable interfaces and requires a capability for test-driver software to read and write the memory used in execution of the SUT. This algorithm identifies all SUT code execution addresses where errors are to be injected, then temporarily replaces the code at those addresses with small test code sequences to inject latent severe errors, then determines whether, as desired, the SUT detects the errors and recovers.

This work was done by Thomas K. Gender and James Chow of Honeywell, Inc., for Johnson Space Center.

Title to this invention has been waived under the provisions of the National Aeronautics and Space Act {42 U.S.C. 2457(f)}, to Honeywell, Inc. Inquiries concerning licenses for its commercial development should be addressed to:

Satellite Systems Operation
Honeywell, Inc.
P.O. Box 52199
Phoenix, AZ 85072-2199

Refer to MSC-23463-1/4-1, volume and number of this NASA Tech Briefs *issue, and the page number.*

Guidance and Control System for a Satellite Constellation

Goddard Space Flight Center, Greenbelt, Maryland

A distributed guidance and control algorithm was developed for a constellation of satellites. The system repositions satellites as required, regulates satellites to desired orbits, and prevents collisions.

1. Optimal methods are used to compute nominal transfers from orbit to orbit.
2. Satellites are regulated to maintain the desired orbits once the transfers are complete.
3. A simulator is used to predict potential collisions or near-misses.
4. Each satellite computes perturbations to its controls so as to increase any unacceptable distances of nearest approach to other objects.
   a. The avoidance problem is recast in a distributed and locally-linear form to arrive at a tractable solution.
   b. Plant matrix values are approximated via simulation at each time step.
   c. The Linear Quadratic Gaussian (LQG) method is used to compute perturbations to the controls that will result in increased miss distances.
5. Once all danger is passed, the satellites return to their original orbits, all the while avoiding each other as above.
6. The delta-Vs are reasonable. The controller begins maneuvers as soon as practical to minimize delta-V.
7. Despite the inclusion of trajectory simulations within the control loop, the algorithm is sufficiently fast for available satellite computer hardware.
8. The required measurement accuracies are within the capabilities of modern inertial measurement devices and modern positioning devices.

This work was done by Jonathan Lamar Bryson, Chadwick James Cox, Paul Richard Mays, James Christian Neidhoefer, and Richard Ephrain Sacks of Accurate Automation Corp. for Goddard Space Flight Center.

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

Accurate Automation Corp.
7001 Shallowford Road
Chattanooga, TN 37421

Refer to GSC-14990-1, volume and number of this NASA Tech Briefs *issue, and the page number.*