Centralized Alert-Processing and Asset Planning for Sensorwebs

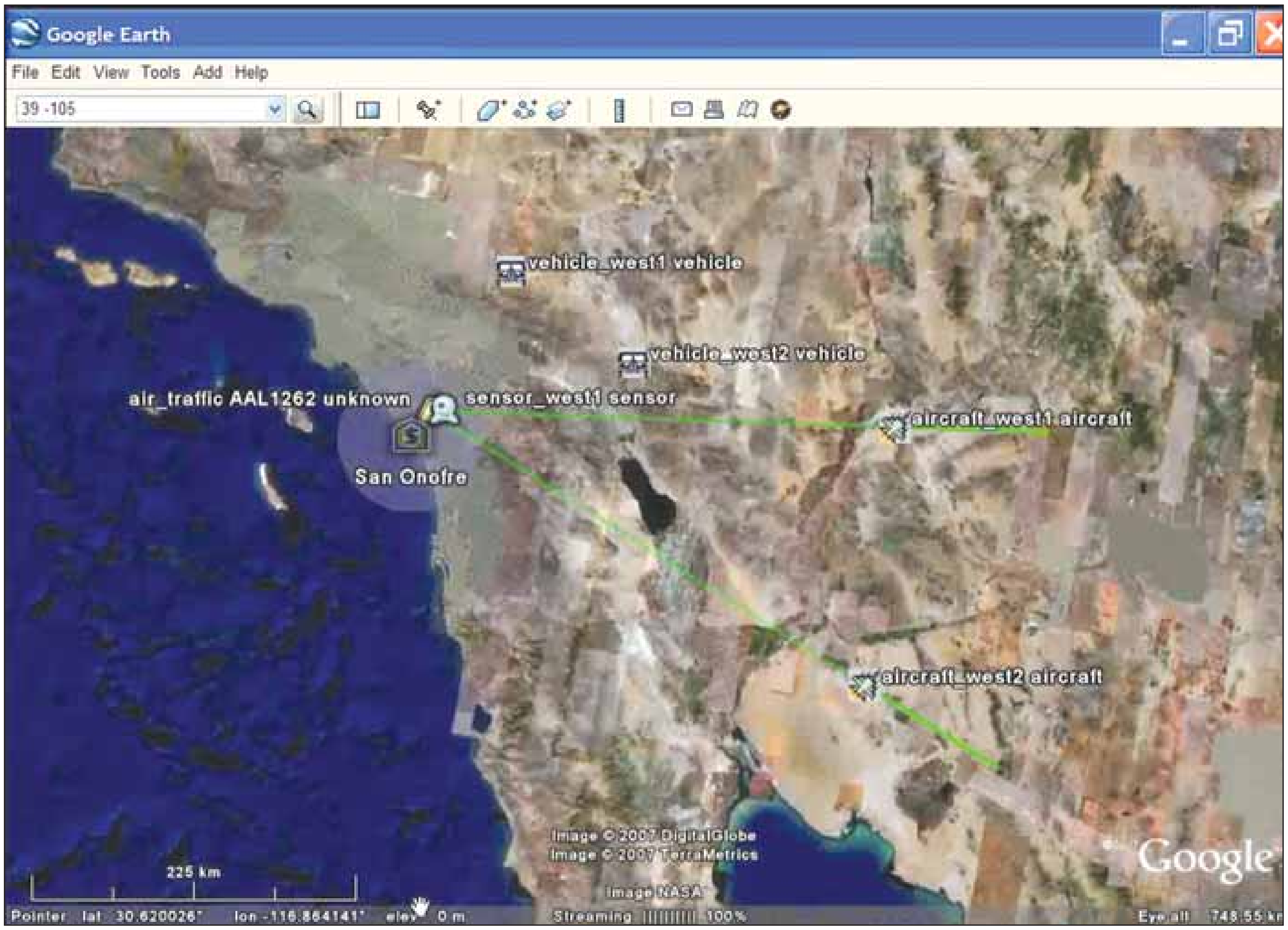
NASA's Jet Propulsion Laboratory, Pasadena, California

A software program provides a Sensorweb architecture for alert-processing, event detection, asset allocation and planning, and visualization (see figure). It automatically tasks and re-tasks various types of assets such as satellites and robotic vehicles in response to alerts (fire, weather) extracted from various data sources, including low-level Webcam data. JPL has adapted considerable Sensorweb infrastructure that had been previously applied to NASA Earth Science applications. This NASA Earth Science Sensorweb has been in operational use since 2003, and has proven reliability of the Sensorweb technologies for robust event detection and autonomous response using space and ground assets.

Unique features of the software include flexibility to a range of detection and tasking methods including those that require aggregation of data over spatial and temporal ranges, generality of the response structure to represent and implement a range of response campaigns, and the ability to respond rapidly.

This work was done by Rebecca Castano, Steve A. Chien, Gregg R. Rabideau, and Benyang Tang of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov.

This software is available for commercial licensing. Please contact Daniel Broderick of the California Institute of Technology at danielb@caltech.edu. Refer to NPO-46468.


Google Earth
File Edit View Tools Add Help
39 -105
vehicle_west1 vehicle
vehicle_west2 vehicle
air_traffic AAL1262 unknown
sensor_west1 sensor
aircraft_west1 aircraft
San Onofre
aircraft_west2 aircraft
Image © 2007 DigitalGlobe
Image © 2007 TerraMetrics
Image NASA
225 km
Google
Pointer lat 30.620026° lon -116.864141° elev 0 m
Streaming |||||||||| 100%
Eye alt 748.55 km

The **Map** is updated to show both planned asset routes as well as actual routes taken.

Support for Systematic Code Reviews With the SCRUB Tool

NASA's Jet Propulsion Laboratory, Pasadena, California

SCRUB is a code review tool that supports both large, team-based software development efforts (e.g., for mission software) as well as individual tasks. The tool was developed at JPL to support a new, streamlined code review process that combines human-generated review reports with program-generated review reports from a customizable range of state-of-the-art source code analyzers. The leading commercial tools include Codesonar, Coverity, and Klocwork, each of which can achieve a reasonably low rate of false-positives in the warnings that they generate. The time required to analyze code with these tools can vary greatly. In each case, however, the tools produce results that would be difficult to realize with human code inspections alone. There is little overlap in the results produced by the different analyzers, and each analyzer used generally increases the effectiveness of the overall effort. The SCRUB tool allows all reports to be accessed through a single, uniform interface (see figure) that facilitates browsing code and reports. Improvements over existing software include significant simplification, and leveraging of a range of commercial, static source code analyzers in a single, uniform framework.

The tool runs as a small stand-alone application, avoiding the security problems related to tools based on Web-browsers. A developer or reviewer, for instance, must have already obtained access rights to a code base before that code can be browsed and reviewed with the SCRUB tool. The tool cannot open any files or folders to which the user does not already have access. This means that the tool does not need to enforce or administer any additional security policies. The analysis results presented through the SCRUB tool's user interface are always computed off-line, given that, especially for larger projects, this computation can take longer than appropriate for interactive tool use.

The recommended code review process that is supported by the SCRUB tool consists of three phases: Code Review, Developer Response, and Closeout Resolution. In the Code Review phase, all tool-based analysis reports are generated, and specific comments from expert code reviewers are entered into the SCRUB tool. In the second phase, Developer Response, the developer is asked to respond to each comment and tool-report that was produced, either agreeing or disagreeing to provide a fix that addresses the issue that was raised. In the third phase, Closeout Resolution, all disagreements are discussed in a meeting of all parties involved, and a resolution is made for all disagreements. The first two phases generally take one week each, and the third phase is concluded in a single closeout meeting.

This work was done by Gerard J. Holzmann of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

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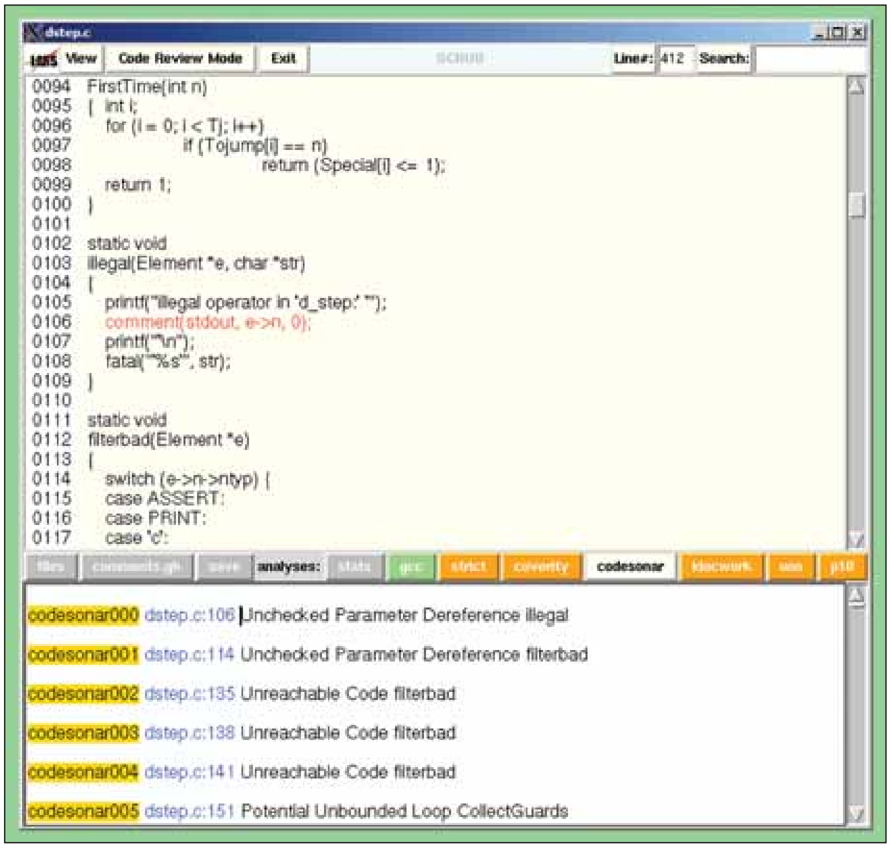

```
0094  FirstTime(int n)
0095  {  int i;
0096     for (i = 0; i < Tj; i++)
0097              if (Tojump[i] == n)
0098                       return (Special[i] <= 1);
0099     return 1;
0100  }
0101
0102  static void
0103  illegal(Element *e, char *str)
0104  {
0105     printf("illegal operator in 'd_step:' '");
0106     comment(stdout, e->n, 0);
0107     printf("'\n");
0108     fatal("'%s'", str);
0109  }
0110
0111  static void
0112  filterbad(Element *e)
0113  {
0114     switch (e->n->ntyp) {
0115     case ASSERT:
0116     case PRINT:
0117     case 'c':
```

```
codesonar000 dstep.c:106 Unchecked Parameter Dereference illegal
codesonar001 dstep.c:114 Unchecked Parameter Dereference filterbad
codesonar002 dstep.c:135 Unreachable Code filterbad
codesonar003 dstep.c:138 Unreachable Code filterbad
codesonar004 dstep.c:141 Unreachable Code filterbad
codesonar005 dstep.c:151 Potential Unbounded Loop CollectGuards
```

SCRUB User Interface is shown when it is opened in local mode.

Numerical Mean Element Orbital Analysis With Morbiter

NASA's Jet Propulsion Laboratory, Pasadena, California

The Morbiter software numerically averages an osculating orbit's equations of motion (EOM) to arrive at the mean orbit's EOMs, which are then numerically propagated to obtain the long-term orbital ephemerides. The long-term evolution characteristics, and stability, of an orbit are best characterized using a mean element propagation of the perturbed, two-body variational equations of motion. The average process eliminates short period terms, leaving only secular and long period effects. Doing this avoids the Fourier series expansions and truncations required by the traditional analytic methods.

The numerical methods require no analytic approximation, and the averaging theory and software implementation work at any solar system body. JPL's Monte mission analysis and navigation software was used as the underlying trajectory system (to the extent possible) for this innovation.

Morbiter is a package of Python scripts that implement the algorithms, and uses Monte for basic astrodynamics constructs and functions such as trajectories, ephemerides, coordinate systems, astrodynamics constants, and, in most cases, the perturbation acceleration methods. Python is an interpreted language that provides an ideal platform for rapid development of algorithms; however, there is a performance penalty for using Python script-based applications. An end-user, future version of Morbiter that is fully compiled will not suffer from this speed penalty; development of this version is planned to begin in late FY '10.

This work was done by Todd A. Ely of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov.

This software is available for commercial licensing. Please contact Daniel Broderick of the California Institute of Technology at danielb@caltech.edu. Refer to NPO-47212.