Information Sciences

Algorithm for Automated Detection of Edges of Clouds

The algorithm has been shown to be reliable and robust.

John F. Kennedy Space Center, Florida

An algorithm processes cloud-physics data gathered *in situ* by an aircraft, along with reflectivity data gathered by ground-based radar, to determine whether the aircraft is inside or outside a cloud at a given time. A cloud edge is deemed to be detected when the in/out state changes, subject to a hysteresis constraint. Such determinations are important in continuing research on relationships among lightning, electric charges in clouds, and decay of electric fields with distance from cloud edges.

More specifically, the algorithm consists of an in-cloud detection component and a boundary detection component. The in-cloud detection component relies on the cloud-physics and weather-radar data to make a tentative determination of the in/out state. The boundary detection component examines the output of the in-cloud detection component and applies a hysteresis test, which helps prevent false boundary detections that would otherwise be triggered by momentary data fluctuations associated with isolated transient cloud puffs or data dropouts.

The algorithm was tested by applying it to a large set of data and comparing the results of the algorithm with results obtained through detailed manual examination of the data. The algorithm was found to be highly reliable and insensitive to transient instrumentation noise or data gaps, and it enabled full automation of detection of cloud edges.

This work was done by Jennifer G. Ward and Francis J. Merceret of **Kennedy Space Center**. *Further information is contained in a TSP (see page 1)..*
KSC-12574

Exploiting Quantum Resonance to Solve Combinatorial Problems

NASA's Jet Propulsion Laboratory, Pasadena, California

Quantum resonance would be exploited in a proposed quantum-computing approach to the solution of combinatorial optimization problems. In quantum computing in general, one takes advantage of the fact that an algorithm cannot be decoupled from the physical effects available to implement it. Prior approaches to quantum computing have involved exploitation of only a subset of known quantum physical effects, notably including parallelism and entanglement, but not including resonance. In the proposed approach, one would utilize the combinatorial properties of tensor-product decomposability of unitary evolution of many-particle quantum systems for physically simulating solutions to NP-complete problems (a class of problems that are intractable with respect to classical methods of computation). In this approach, reinforcement and selection of a desired solution would be executed by means of quantum resonance. Classes of NP-complete problems that are important in practice and could be solved by the proposed approach include planning, scheduling, search, and optimal design.

This work was done by Michail Zak and Amir Fijany of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*
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Hybrid Terrain Database

Aerial photographs are draped onto digital elevation maps.

Langley Research Center, Hampton, Virginia

A prototype hybrid terrain database is being developed in conjunction with other databases and with hardware and software that constitute subsystems of aerospace cockpit display systems (known in the art as synthetic vision systems) that generate images to increase pilots' situation awareness and eliminate poor visibility as a cause of aviation accidents. The basic idea is to provide a clear view of the world around an aircraft by displaying computer-generated imagery derived from an onboard database of terrain, obstacle, and airport information.

The hybrid terrain database, which could constitute all or part of such an onboard database, can be characterized as an accurate model of terrain and obstacles of interest to a pilot. The hybrid terrain database contains (1) imagery derived from conventional aerial photo-
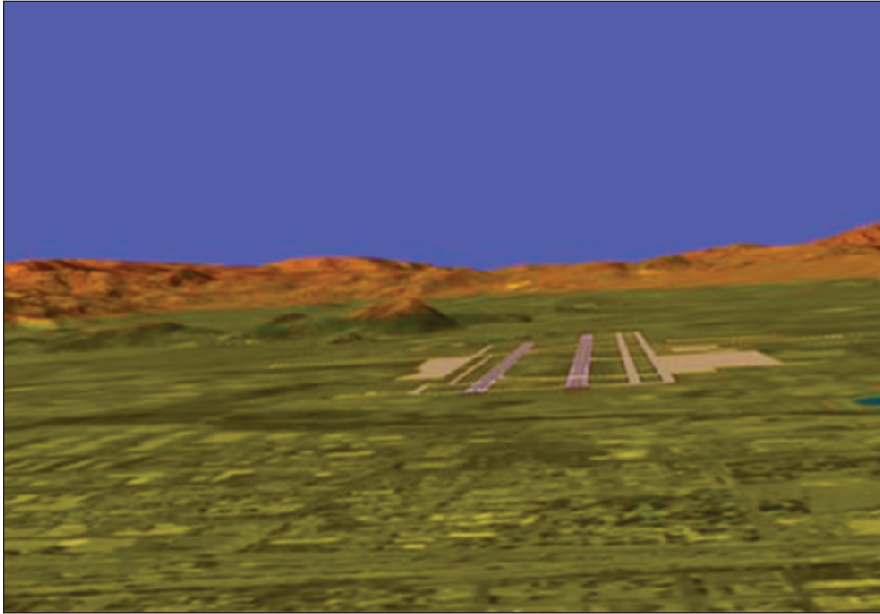
This **Hybrid Textured Terrain** image was generated from a hybrid terrain database of Reno-Tahoe International Airport and its environs.

graphs of a terrain area of interest, (2) a digital elevation map of the terrain area of interest, and, optionally, (3) information on the area of interest from other databases.

The hybrid terrain database is used to generate synthetic terrain imagery (see figure) in a hybrid textured format, which is best described in terms of the process by which the synthetic imagery is generated: The hybrid texture is created from monochromatic aerial photographs of the affected terrain area merged with color-coded elevation-based terrain imagery (see figure). The process involves coloring the monochromatic aerial photographs of the affected area on the basis of altitude and draping the resulting elevation-colored photographs onto the digital elevation model of the terrain.

This work was done by Trey Arthur of **Langley Research Center**. *Further information is contained in a TSP (see page 1).*
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