



Large Fluvial Fans and Exploration for Hydrocarbons

A report discusses the geological phenomena known, variously, as modern large (or large modern) fluvial fans or large continental fans, from a perspective of exploring for hydrocarbons. These fans are partial cones of river sediment that spread out to radii of 100 km or more. Heretofore, they have not been much recognized in the geological literature — probably because they are difficult to see from the ground. They can, however, be seen in photographs taken by astronauts and on other remotely sensed imagery. Among the topics discussed in the report is the need for research to understand what seems to be an association among fluvial fans, alluvial fans, and hydrocarbon deposits. Included in the report is an abstract that summarizes the global distribution of large modern fluvial fans and a proposal to use that distribution as a guide to understanding paleo-fluvial reservoir systems where oil and gas have formed. Also included is an abstract that summarizes what a continuing mapping project has thus far revealed about the characteristics of large fans that have been found in a variety of geological environments.

This work was done by Murray Justin Wilkinson of Lockheed Martin Corp. for Johnson Space Center.

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Johnson Space Center, (281) 483-0837. Refer to MSC-23424.

Doping-Induced Interband Gain in InAs/AlSb Quantum Wells

A paper describes a computational study of effects of doping in a quantum well (QW) comprising a 10-nm-thick layer of InAs sandwiched between two 21-nm-thick AlSb layers. Heretofore, InAs/AlSb QWs have not been useful as interband gain devices because they have type-II energy-band-edge alignment, which causes spatial separation of

electrons and holes, thereby leading to weak interband dipole matrix elements. In the doping schemes studied, an interior sublayer of each AlSb layer was doped at various total areal densities up to $5 \times 10^{12} \text{ cm}^{-2}$. It was found that (1) proper doping converts the InAs layer from a barrier to a well for holes, thereby converting the heterostructure from type II to type I; (2) the resultant dipole matrix elements and interband gains are comparable to those of typical type-I heterostructures; and (3) dipole moments and optical gain increase with the doping level. Optical gains in the transverse magnetic mode can be almost ten times those of other semiconductor material systems in devices used to generate medium-wavelength infrared (MWIR) radiation. Hence, doped InAs/AlSb QWs could be the basis of an alternative material system for devices to generate MWIR radiation.

This work was done by K. I. Kolokolov and C. Z. Ning of Ames Research Center. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Ames Research Center, (650) 604-5104. Refer to ARC-15157-1

Development of Software for a Lidar-Altitude Processor

A report describes the development of software for a digital processor that operates in conjunction with a finite-impulse-response (FIR) chip in a spaceborne lidar altimeter. Processing is started by a laser-fire interrupt signal that is repeated at intervals of 25 ms. For the purpose of discriminating between returns from the ground and returns from such things as trees, buildings, and clouds, the software is required to scan digitized lidar-return data in reverse of the acquisition sequence in order to distinguish the last return pulse from within a commanded ground-return range window. The digitized waveform information within this range window is filtered through 6 matched filters, in the hardware electronics, in order to maximize the probability of finding echoes from sloped or rough terrain and minimize the probability of selecting cloud returns. From

the data falling past the end of the range window, there is obtained a noise baseline that is used to calculate a threshold value for each filter. The data from each filter is analyzed by a complex weighting scheme and the filter with the greatest weight is selected. A region around the peak of the ground-return pulse associated with the selected filter is placed in telemetry, as well as information on its location, height, and other characteristics. The software requires many uplinked parameters as input. Included in the report is a discussion of major software-development problems posed by the design of the FIR chip and the need for the software to complete its process within 20 ms to fit within the overall 25-ms cycle.

This work was done by Jacob S. Rosenberg and Carlos Trujillo of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-14382

Upgrading the Space Shuttle Caution and Warning System

A report describes the history and the continuing evolution of an avionic system aboard the space shuttle, denoted the caution and warning system, that generates visual and auditory displays to alert astronauts to malfunctions. The report focuses mainly on planned human-factors-oriented upgrades of an alphanumeric fault-summary display generated by the system. Such upgrades are needed because the display often becomes cluttered with extraneous messages that contribute to the difficulty of diagnosing malfunctions. In the first of two planned upgrades, the fault-summary display will be rebuilt with a more logical task-oriented graphical layout and multiple text fields for malfunction messages. In the second upgrade, information displayed will be changed, such that text fields will indicate only the sources (that is, root causes) of malfunctions; messages that are not operationally useful will no longer appear on the displays. These and other aspects of the upgrades are based on extensive collaboration among astronauts, engineers, and human-factors scientists. The report describes the human-factors principles applied in the upgrades.

*This report was written by Jeffrey W. McCandless and Robert S. McCann of Ames Research Center and Bruce R. Hilty of Johnson Space Center. Further information is contained in a TSP (see page 1).
ARC-15178-1*



Fractal Reference Signals in Pulse-Width Modulation

A report proposes the use of waveforms having fractal shapes reminiscent of sawteeth (in contradistinction to conventional regular sawtooth waveforms) as ref-

erence signals for pulse-width modulation in control systems for thrusters of spacecraft flying in formation. Fractal reference signals may also be attractive in some terrestrial control systems — especially those in which pulse-width modulation is used for precise control of electric motors. The report asserts that the use of fractal reference signals would enable the synchronous control of several variables of a spacecraft formation, such that consumption of propellant would be minimized, intervals between thruster firings would be long (as preferred for performing scientific observations), and delays in con-

trolling large-thrust maneuvers for retargeting would be minimized. The report further asserts that whereas different controllers would be needed for different modes of operation if conventional pulse-width modulation were used, the use of fractal reference signals would enable the same controller to function nearly optimally in all regimes of operation, so that only this one controller would be needed.

*This work was done by Boris Lurie of Caltech and Helen Lurie of UCLA for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).
NPO-30402*