



## Books & Reports

### Combined GMSK Communications and PN Ranging

A document discusses a method by which GMSK (Gaussian minimum shift keying) modulation and a pseudonoise (PN) ranging signal may be combined. By isolating the in-phase and quadrature components after carrier lock, and extracting their low-pass and band-pass filtered components, there is enough information available to both demodulate data and track the PN signal. The proposed combined GMSK communications and PN ranging is one potential approach to address emerging requirements for simultaneous high data rate communications from and tracking of vehicles in deep space or at the Moon.

GMSK and PN ranging have not been previously combined, and the corresponding receiver structure for such combined ranging has not been proposed in the past. A key advantage is that the combined signal is bandwidth-efficient and it is a constant envelope modulation, allowing high-power amplifiers to operate at saturation for highest efficiency.

*This work was done by Richard Orr of SATEL LLC and Dariush Divsalar of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-45108*

### System-Level Integration of Mass Memory

A report discusses integrating multiple memory modules on the high-speed serial interconnect (IEEE 1393) that is used by a spacecraft's inter-module communications in order to ease data congestion and provide for a scalable, strong, flexible system that can meet new system-level mass memory requirements.

Using the JPL 1393 Ring Bus Interconnect to link computer elements, I/O, and memory allows any element to communicate with any other element. Besides providing a consistent approach to exchanging data, it inherently has a layer of abstraction that allows for better system and software design. This new architecture is fault-tolerant and provides a large range of scalability while supporting flexible spacecraft architectures that are currently being investigated.

*This work was done by Brian Cox, Jeffrey Mellstrom, and Terry Wysocky of Caltech*

*for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).*

*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:*

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*Refer to NPO-45205, volume and number of this NASA Tech Briefs issue, and the page number.*

### Network-Attached Solid-State Recorder Architecture

A document discusses placing memory modules on the high-speed serial interconnect, which is used by a spacecraft's computer elements for inter-processor communications, to allow all multiple computer system architectures to access the spacecraft data storage at the same time. Each memory board is identical electrically and receives its bus ID upon connection to the system. The computer elements are configured in a similar fashion. The architecture allows for multiple memory boards to be accessed simultaneously by different computer elements, and results in a scalable, strong, fault-tolerant system. The IEEE-1393 ring bus can be routed so that multiple card failures can occur and the mass memory storage will still function.

*This work was done by Brian Cox of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-45204*

### Method of Cross-Linking Aerogels Using a One-Pot Reaction Scheme

A document discusses a new, simplified method for cross-linking silica and other oxide aerogels, with a polymeric material to increase strength of such materials without adversely affecting porosity or low density. The usual process is long and arduous, requiring multiple washing and soaking steps to infiltrate oxide with the polymer precursor after gelation. Additionally, diffusion prob-

lems can result in aerogel monoliths that are not uniformly cross-linked.

This innovation introduces the polymer precursor into the sol before gelation either as an agent, which co-reacts with the oxide gel, or as soluble polymer precursors, which do not interact with the oxide gel in any way. Subsequent exposure to heat, light, catalyst or other method of promoting polymerization causes cross-linking without any additional infiltration steps.

The resulting aerogel monolith is more uniform because this process does not suffer from diffusion issues that previous methods have. Also, in instances where complete polymerization requires a balanced stoichiometry, this requirement is more easily met.

*This work was done by Mary Ann B. Meador and Lynn A. Capadona of Glenn 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 NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steve Fedor, Mail Stop 4-8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18042.*

### An Efficient Reachability Analysis Algorithm

A document discusses a new algorithm for generating higher-order dependencies for diagnostic and sensor placement analysis when a system is described with a causal modeling framework. This innovation will be used in diagnostic and sensor optimization and analysis tools. Fault detection, diagnosis, and prognosis are essential tasks in the operation of autonomous spacecraft, instruments, and *in-situ* platforms. This algorithm will serve as a power tool for technologies that satisfy a key requirement of autonomous spacecraft, including science instruments and *in-situ* missions.

In the causal modeling, the system is modeled in terms of first-order cause-and-effect dependencies; i.e., how the fault propagates from a faulty component to its immediate neighbors. For diagnostic purpose, also global (or higher-order) dependencies are needed, which is the effect of a fault on non-neighbor components. The global dependencies should be inferred from the first-order

dependencies. The method that finds these dependencies is called a reachability analysis algorithm. The result of this algorithm determines at each test point (or sensor position) which of the failure sources can be observed.

The standard reachability analysis algorithm uses a “token propagation” method. The complexity of this algo-

rithm is proportional to the product  $EN$ , where  $E$  is the number of links (edges) of the graph of the system and  $N$  is the number of components. Here a new algorithm is introduced. The complexity of this algorithm is proportional to the product  $dN$ , where  $d$  is the length of the longest (directed) path in the graph of the system. To compare the perform-

ance of these two algorithms, first it is noted that always  $d \leq E$ . But typically,  $d$  is of the order of  $\log(E)$ ; thus the new algorithm, in general, outperforms the standard algorithm.

*This work was done by Farrokh Vatan and Amir Fijany of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-45797*