ther the present LDPC-PPM scheme or the prior SCPPM scheme. At the transmitting terminal, the original data \((u)\) are processed by an encoder into blocks of bits \((a)\), and the encoded data are mapped to PPM of an optical signal \((c)\). For the purpose of design and analysis, the optical channel in which the PPM signal propagates is modeled as a Poisson point process. At the receiving terminal, the arriving optical signal \((y)\) is demodulated to obtain an estimate \((\hat{a})\) of the coded data, which is then processed by a decoder to obtain an estimate \((\hat{u})\) of the original data.

The demodulation and decoding sub-processes are iterated to improve the final estimates in an attempt to reconstruct the original data stream \((u)\) exactly. The decoder implements a soft-input/soft-output (SISO) algorithm. This or any SISO decoder receives, as soft inputs, noisy versions (estimates and log-likelihoods of the estimates) of the input and output of the encoder and produces updated log-likelihoods of the estimates of the input, the output, or both. These estimates and their log-likelihoods may then be transmitted to other SISO modules in the receiver, where they are treated as noisy inputs.

In comparison with non-iterative alternatives, both the present LDPC-PPM scheme and the prior SCPPM scheme offer better performance. In comparison with iterative alternatives, both schemes afford better performance with less complexity. In comparison of these schemes with each other, each is partly advantageous and partly disadvantageous: For example, computational simulations have shown that for a block length of about 8Kb, the performance of the prior SCPPM scheme is about 0.8 dB away from the theoretical channel capacity, while the performance of the LDPC-PPM scheme is expected to be about 1.2 dB away from the theoretical channel capacity at a bit-error rate of about \(2 \times 10^{-5}\) (see Figure 2); in other words, the performance of the LDPC-PPM scheme is expected to be about 0.4 dB below that of the prior SCPPM scheme. On the other hand, unlike the prior SCPPM scheme, the LDPC-PPM scheme is lends itself very well to low-latency parallel processing. Either scheme could serve as the basis of design of an optical communication system, depending on requirements pertaining to the PPM order, latency, and architecture of the system.

This work was done by Maged Barsoum, Bruce Moision, Dariush Divsalar, and Jon Hamkins of Caltech and Michael Fitz of UCLA for NASA’s Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-44408

**Complex Event Recognition Architecture**

*Lyndon B. Johnson Space Center, Houston, Texas*

“Complex Event Recognition Architecture” (“CERA”) is the name of a computational architecture, and software that implements the architecture, for recognizing complex event patterns that may be spread across multiple streams of input data. One of the main components of CERA is an intuitive event pattern language that simplifies what would otherwise be the complex, difficult tasks of creating logical descriptions of combinations of temporal events and defining rules for combining information from different sources over time. In this language, recognition...
patterns are defined in simple, declarative 
statements that combine point 
events from given input streams with 
those from other streams, using 
conjunction, disjunction, and negation. 
Patterns can be built on one another re-
cursively to describe very rich, tempo-
raly extended combinations of events. 
Thereafter, a run-time matching algo-

in CERA efficiently matches 
these patterns against input data and 
signals when patterns are recognized. 

CERA can be used to monitor complex 
systems and to signal operators or initiate 
corrective actions when anomalous condi-
tions are recognized. CERA can be run as 
a stand-alone monitoring system, or it can 
be integrated into a larger system to auto-
matically trigger responses to changing 
environments or problematic situations. 

This program was written by William A. 
Fitzgerald and R. James Firby of I/NET, Inc. for 
Johnson Space Center. 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: 
I/NET 
P. O. Box 3338 
Kalamazoo, MI 49003 
Phone No.: (269) 978-6816 
Fax No.: (800) 673-7352 
Refer to MSC-23637-1, volume and num-
ber of this NASA Tech Briefs issue, and the 
page number.

TurboTech Technical Evaluation Automated System
Goddard Space Flight Center, Greenbelt, Maryland

TurboTech software is a Web-based 
process that simplifies and semiauto-
mates technical evaluation of NASA 
proposals for Contracting Officer’s 
Technical Representatives (COTRs). At 
the time of this reporting, there have 
been no set standards or systems for 
training new COTRs in technical evalua-
tions. This new process provides boil-
erplate text in response to “interview-
style” questions. This text is collected 
into a Microsoft Word document that 
can then be further edited to conform 
to specific cases. 

By providing technical language and a 
structured format, TurboTech allows the 
COTRs to concentrate more on the ac-
tual evaluation, and less on deciding 
what language would be most appropri-
ate. Since the actual word choice is one 
of the more time-consuming parts of a 
COTRs’ job, this process should allow 
for an increase in quantity of proposals 
evaluated.

TurboTech is applicable to composing 
technical evaluations of contractor pro-
posal, task and delivery orders, change 
order modifications, requests for pro-
posals, new work modifications, task as-
signments, as well as any changes to ex-
ist contracts. 

This work was done by Dorothy J. Tiffany 
of Goddard Space Flight Center. Further infor-
mation is contained in a TSP (see page 1). 
GSC-15554-1

Robot Vision Library
NASA’s Jet Propulsion Laboratory, Pasadena, California

The JPL Robot Vision Library (JPLV) 
provides real-time robot vision algo-
rithms for developers who are not vi-
sion specialists. The package includes 
algorithms for stereo ranging, visual 
odometry and unsurveyed camera cali-
bration, and has unique support for 
very wide-angle lenses (as used on the 
Mars Exploration Rover HazCams). 
JPLV gathers these algorithms into one 
uniform, documented, and tested pack-
age with a consistent C API (application 
programming interface). The software 
is designed for real-time execution 
(10–20 Hz) on COTS (commercial, off-
the-shelf) workstations and embedded 
processors. 

This package incorporates algorithms 
developed over more than ten years of 
research in ground and planetary robot-
ics for NASA, DARPA (Defense Ad-
vanced Research Projects Agency) and 
the Army Research Labs, and is cur-
cently being used in applications as di-
verse as legged vehicle navigation and 
large-scale urban modeling. 

This work was done by Andrew B. 
Howard, Adnan I. Ansar, and Todd E. 
Litwin of Caltech and Steven B. Goldberg of 
Indelible Systems for NASA’s Jet Propulsion 
Laboratory. 

This software is available for commercial 
licensing. Please contact Karina Edmonds of 
the California Institute of Technology at 
(626) 395-2322. Refer to NPO-46532.

Perl Modules for Constructing Iterators
Goddard Space Flight Center, Greenbelt, Maryland

The Iterator Perl Module provides a 
general-purpose framework for con-
structing iterator objects within Perl, 
and a standard API for interacting with 
those objects. Iterators are an object-ori-
ented design pattern where a descrip-
tion of a series of values is used in a con-
structor. Subsequent queries can request 
values in that series. These Perl modules 
build on the standard Iterator framework 
and provide iterators for some other 
types of values. 

Iterator::DateTime constructs iterators 
from DateTime objects or Date::Parse de-
scriptions and ICal/RFC 2445 style re-