Information Sciences

Single-Point Access to Data Distributed on Many Processors

NASA's Jet Propulsion Laboratory, Pasadena, California

A description of the functions and data structures is defined that would be necessary to implement the Chapel concept of distributions, domains, allocation, access, and interfaces to the compiler for transformations from Chapel source to their run-time implementation for these concepts. A complete set of object-oriented operators is defined that enables one to access elements of a distributed array through regular arithmetic index sets, giving the programmer the illusion that all the elements are collocated on a single processor. This means that arbitrary regions of the arrays can be fragmented and distributed across multiple processors with a single point of access. This is important because it can significantly improve programmer productivity by allowing the programmers to concentrate on the high-level details of the algorithm without worrying about the efficiency and commu-nication details of the underlying representation.

Estimating Dust and Water Ice Content of the Martian Atmosphere From THEMIS Data

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Researchers at JPL and Arizona State University conducted a comparative study of three candidate algorithms for estimating components of the Martian atmosphere, using raw (uncalibrated) data collected by the Thermal Emission Imaging System (THEMIS). THEMIS is an instrument onboard the Mars Odyssey spacecraft that acquires image data in five visible and nine infrared (IR) wavelength bands. The algorithms under study used data collected from eight of the nine IR bands to estimate the dust and water ice content of the atmosphere. Such an algorithm could be used in onboard data processing to trigger other algorithms that search for features of scientific interest and to reduce the volume of data transmitted to Earth.

The algorithms studied were based on regression models. In the study, the optical depths estimated by these algorithms were compared with optical depths estimated in ground-based processing using fully calibrated data from both THEMIS and the Thermal Emission Spectrometer (TES). TES is an instrument onboard the Mars Global Surveyor spacecraft that also observes the planet at infrared wavelengths, but at a lower spatial resolution than THEMIS does. Of the algorithms studied, the one that performed best was based on a Gaussian Support Vector Machine regression model. The test results indicated that this algorithm, operating on the raw data, had error rates that were within the uncertainty associated with the estimates obtained by the ground-based analysis of the fully calibrated data. This level of fidelity demonstrates that these algorithms are sufficiently accurate for use in an onboard setting.

Computing a Stability Spectrum by Use of the HHT
Unlike in the predecessor method, the mathematical sign of the damping is retained.

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The Hilbert-Huang transform (HHT) is part of the mathematical basis of a method of calculating a stability spectrum. This method can be regarded as an extended and improved version of a prior HHT-based method of calculating a damping spectrum. In the prior method, information on positive damping (which leads to stability) and negative damping (which leads to instability) becomes mixed into a single squared damping loss factor. Hence, there is no way to distinguish between stability and instability by examining a damping spectrum. In contrast, in the present stability-spectrum method, information on the mathematical sign of the damping is retained, making it possible to identify re-