Geophysical Research Abstracts
Vol. 13, EGU2011-8641, 2011
EGU General Assembly 2011
© Author(s) 2011

High Performance Computing in Complex Environments: Applications to Hyperspectral Remote Sensing Data Analysis

Antonio Plaza
(aplaza@unex.es)

Remote sensing applications often require solving complex and challenging problems with high computational cost. Examples include, among many others, environmental modeling and assessment for Earth-based and atmospheric studies, hydrology, meteorology, risk/hazard prevention and response including wild land fire tracking, biological threat detection, monitoring of oil spills and other types of chemical contamination, target detection for military and defense/security purposes, urban planning and management studies, etc.

To address these relevant problems, remote sensing instruments are continuously increasing their spatial, spectral and temporal resolutions. Such wealth of information has also introduced new processing challenges. Nowadays, the emergence of heterogeneous computing allows research groups, enterprises and educational institutions to use networks of processors which are already available. On the other hand, high performance computers have become more and more hierarchical and heterogeneous, e.g., a cluster of multiprocessor nodes may no longer considered a state-of-the-art platform, since the incorporation of multi-core processors and specialized hardware accelerators as graphical processing units (GPUs) or field programmable gate arrays (FPGAs) can increase computational performance significantly at a very low cost, commensurate with falling costs in the market. These modern hierarchical and heterogeneous computing infrastructures are harder to program and use efficiently, but specific tools able to address the heterogeneity of such systems are becoming available in the community.

In this presentation, we will provide our experience and recent developments in the application of high performance computing techniques and practices in complex environments oriented towards solving a specific remote sensing problem: the analysis of remotely sensed hyperspectral images. This emerging and fast growing technique is concerned with the measurement, analysis, and interpretation of spectra acquired from a given scene (or specific object) at a short, medium or long distance by an airborne or satellite sensor. The wealth of spectral information available from latest-generation hyperspectral imaging instruments, including European developments such as the German Environmental Mapping and Analysing Program (EnMAP) or the Italian Hyperspectral Precursor of the Application Mission (PRISMA) leads to the requirement of complex high performance computing techniques at different levels: from efficient storage, management and distribution of high volumes of data across different locations using heterogeneous computing architectures to the need to perform real-time processing of the data on-board the airborne/satellite instruments using specialized hardware devices such as FPGAs or GPUs. These aspects will be covered in the presentation, which will provide a snapshot of the state-of-the-art in this area and a thoughtful perspective on the potential and emerging challenges of applying complex high performance computing paradigms to hyperspectral remote sensing problems. The relationship of hyperspectral remote sensing techniques with other relevant European initiatives, such as the Distributed Research Infrastructure for Hydro-Meteorology Study (DRIHMS), will also be addressed.