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GRID based Thermal Images Processing for volcanic activity monitoring

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Since 2001, the Catania Section of the National Institute of Geophysics and Volcanology (INGV) has been running the video stations recording the volcanic activity of Mount Etna, Stromboli and the Fossa Crater of Vulcano island. The video signals of 11 video cameras (seven operating in the visible band and four in infrared) are sent in real time to INGV Control Centre where they are visualized on monitors and archived on a dedicated NAS storage.
The video surveillance of the Sicilian volcanoes, situated near to densely populated areas, helps the volcanologists providing the Civil Protection authorities with updates in real time on the on-going volcanic activity.
In particular, five video cameras are operating on Mt. Etna and they record the volcano from the south and east sides 24 hours a day.
During emergencies, mobile video stations may also be used to better film the most important phases of the activity. Single shots are published on the Catania Section intranet and internet websites.
On June 2006 a A 40 thermal camera was installed in Vulcano La Fossa Crater. The location was in the internal and opposite crater flank (S1), 400 m distant from the fumarole field. The first two-year of data on temperature distribution frequency were recorded with this new methodology of acquisition, and automatically elaborated by software at INGV Catania Section.
In fact a dedicated software developed in IDL, denominated Volcano Thermo Analysis (VTA), was appositely developed in order to extract a set of important features, able to characterize with a good approssimation the volcanic activity. In particular the program first load and opportunely convert the thermal images, then according to the Region Of Interest (ROI) and the temperature ranges defined by the user provide to automatic spatial and statistic analysis.
In addition the VTA is able to analysis all the temporal series of images available in order to achieve the time-event analysis and the dynamic of the volcanic evolution.
Clearly the analysis of this amount of data requires a lot of CPU and storage resources and this represent a serious limitation, and often this can overwhelm the performance capability of a workstation. Fortunately the INGV and the University of Catania are involved in a project for the development of a GRID infrastructure (a virtual supercomputer created by using a network of independent, geographically dispersed, computing clusters which act like a grid) and in software for this GRID.
The performance of the VTA can be improved by using GRID thanks to its kernel thought to perform analysis for each thermal image independently from the others, and consequently it can be adequately parallelized in such a way the different parts of the same computation job can run on a multiplicity of machines.
In particular the VTA grid version has been conceived considering the application as a Direct Acyclic Graph (DAG): the analysis task is first subdivided in the major number of machines available and then another part of the program proved the aggregation of the results.
Consequently the porting of this software in the GRID environment greatly enhanced VTA's potentialities, allowing us to perform faster and multiple analysis on huge set of data, proving itself as a really usefull instrument for scientific research.