

# SMARTQuake™: A New Automated Earthquake Data Processor

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## Abstract

- Fully automated earthquake data processor for local and distant seismic events
- Based on the SAPS seismological data acquisition and processing system with a proven successful operation over more than eight years at several data centers in Europe
- Modular, easily extendable, fully specialized task
- Available as a stand-alone product or integrated with Geotech's SMARTGeoHub™ Data Server

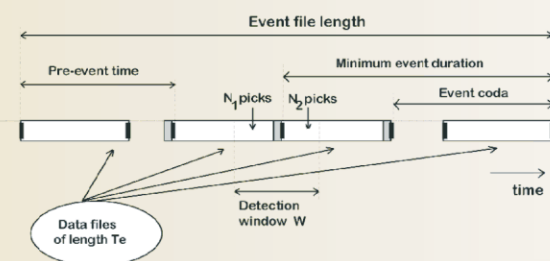
## SMARTQuake™ Input

- Real-time data, continuous or event triggered
- Off-line data collected from field disks

## SMARTQuake™ Features

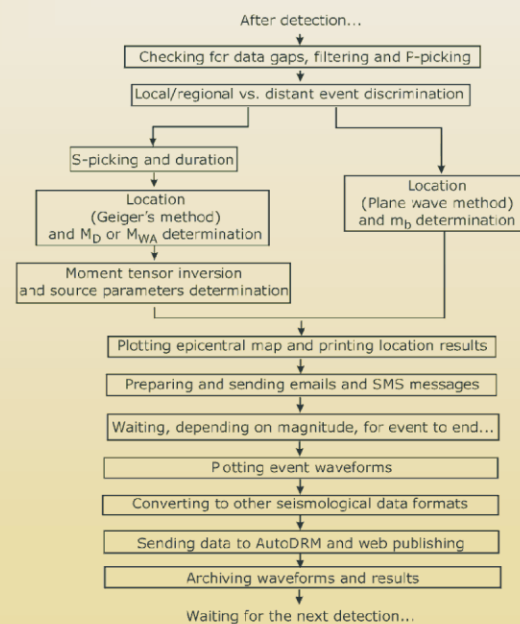
- Picks arrival times on selected channels (including S phases for local events)
- Discriminates between local/regional and distant earthquakes
- Applies different location routines: iterative Geiger method for local/regional earthquakes and plane wave method for teleseisms
- Computes Wood Anderson or duration magnitude for local earthquakes and  $m_b$  for teleseisms
- Zero-trace moment tensor inversion and source parameters determination for local events
- Outputs results, waveforms, epicenter maps and fault plane solutions to a PostScript printer and on-screen
- Archives and converts event files to common seismological data formats
- Rapidly releases the earthquake information by email and/or by SMS
- Sends real-time data stream over the Internet using LISS protocol
- Interfaces to AutoDRM and web publishing

## Detection scheme



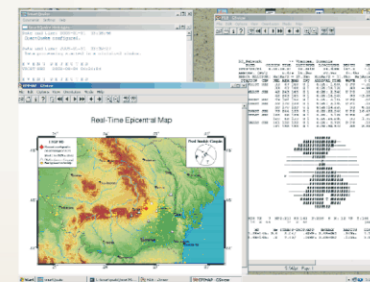
Continuous data files are analyzed sequentially; an event is declared if  $N_1 + N_2 \geq N_{cr}$

## Flow-chart of the processing stages

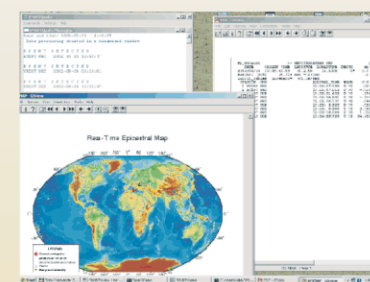


## Screenshots of real-time results

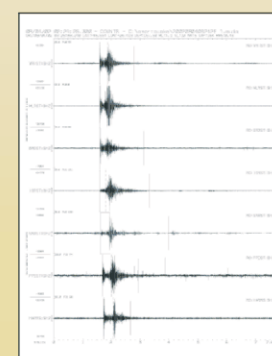
### Local earthquake



### Distant earthquake



### Waveforms of the picked data channels for a local earthquake



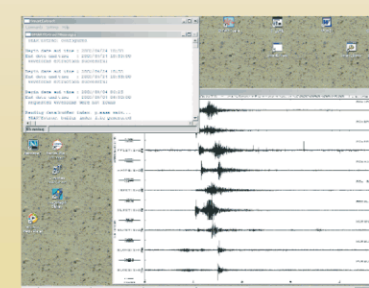
## Automated Seismic Source Inversion

- SMARTQuake™ can perform a zero trace moment tensor inversion for local earthquakes
- The output includes:
  - > the moment tensor components and its principal axes
  - > nodal planes parameters
  - > the scalar seismic moment
  - > source radius, stress drop, energy, dislocation
  - > the best double couple represented on the lower focal hemisphere
- All results are appended to the outgoing emails

## Off-line Data Retrieval

- SMARTQuake™ stores the incoming raw data in a circular buffer for the AutoDRM access
- A specialized tool, SMARTExtract, allows off-line data retrieval from the emails

### SMARTExtract screenshot



## Conclusions

- Advanced earthquake data processing, including seismic source inversion, is performed in real-time. It can be also applied to fast pre-processing of large data sets from temporary station deployments
- Fast and reliable results dissemination made easy via email and AutoDRM
- No human intervention necessary

## SMARTQuake™ is part of the all-new "SMART" Series of Seismological Data Acquisition Systems

★ Geotech Instruments introduces a new generation of 24-bit digitizers, portable recorders and strong motion recorders: it is the Seismological Monitoring and Acquisition in Real Time (SMART) series.

### ★ SMART Series Instruments Features:

- Large selection of recording media (up to 60 GB hard disks, PCMCIA ATA disks, IBM microdrives, Compact Flash memory)
- Extreme low power consumption (<0.75W)
- Complete set of communication ports: serial, Ethernet, USB2.0, IEEE1394, and IrDA.

SMART-24D™ is a full-featured 24-bit digitizer with three or six channels, with up to 2,000 samples per second



★ Geotech Instruments has also developed a new Central Data Acquisition System. The new SMART Central Station is primarily based on the SMARTGeoHub™ Data Server and SMARTGeoViewer™ Real-time Display client.

★ The SMARTGeoHub™ Data Server acquires continuous data streams from SMART-24D™, SMART-24R™, and SMART-24A™ Geotech digitizers, recorders or accelerometers, as well as from other real-time systems, using the CD1.1 communication protocol. The SMARTGeoHub™ Data Server supports different telemetry types (VHF/UHF or spread spectrum radios, telephone, Internet, satellite links) and is built on top of a relational database.

The SMARTGeoViewer™ is a client to the SMARTGeoHub™ and can be used locally or remotely to display real-time data and/or the data accumulated in the database.

