GPS Early Warning System for S. California

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California Real Time Network (CRTN)

- Stations span major faults of southern San Andreas fault system
- Raw GPS data streamed over dedicated radio links (including HPWREN) with a latency of a fraction of a second
- Total displacement waveforms are generated independently every second by instantaneous positioning
- 10-20 Hz data rates have been demonstrated

(http://sopac.ucsd.edu/projects/realtime/)
Test Bed for Early Warning Systems

- Earthquake Geodesy (coseismic motions)
- GPS Seismology (dynamic motions)
- Volcano monitoring
- Structural monitoring
- Landslide monitoring
- Tsunami warning
- Flood Control

Displacement waveforms, 2004 Parkfield event

LA freeway after 1994 Northridge earthquake

2004 Stromboli eruption

Northridge earthquake
CRTN Components

Network
- GPS Station
- Communications
- Raw Data Streams
- RTCM (CSRS)

Data
- RTD Server, SOPAC Database, Web Services, GPS Explorer, SOPAC Utilities
- Positioning Service
- CSRC

Models
- SECTOR CGPS Coordinates
- HTDP Crustal Motion Model
- NGS Geoid Model
- Ionosphere Model
- IGS Precise Orbits
- NOAA Troposphere Model
- SOPAC Archive/Metadata

Models
- Displacement Waveforms
- Troposphere Delays

RTD Server
SOPAC Database
Web Services
GPS Explorer
SOPAC Utilities

Raw Data
User

Single-Base
RTK User
Imperial Valley Survey – October ’08

• Three autonomous teams surveyed about 20 geodetic monuments each in 2-3 days

• Two 15-minute occupations of each monument

• Used CRTN Positioning Service to compute ITRF2005 coordinates

• Positions available at the end of each occupation

• Ideal for post-earthquake surveys

CRTN Components

Network

GPS Station

Data

Communications

RTD Server, SOPAC Database, Web Services, GPS Explorer SOPAC Utilities

Data

Server

Raw Data User

Single-Base RTK User

NMEA (CSRS)

RTCM (CSRS)

Models

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Raw Data streams

Displacement Waveforms

Tropospheric Delays

EWS
Japan’s Geophysical Survey Institute (GSI) operates nationwide 1200-station continuous GPS network (GEONET), with ~ 20 km spacing. Of these, 1156 stations are streaming @ 1 Hz to a central facility in Tsukuba City.
Triangulation Scheme

- Create a Delaunay triangulation of the network every second
- Compute relative positions of each triangle
- Convert to principal components of strain (2D)
- Establish detection criteria to isolate an event
- Determine an anchor point for computing absolute positions
2003 Mw 8.0
Tokachi –Oki earthquake
ShakeOut
Total Displacement Waveforms
Coseismic Displacement Model
California Spatial Reference Center (CSRC) Proposal for a Statewide California Real Time Network

**Multipurpose:**
- Positioning Service
- EWS Test Bed
- GPS Meteorology

http://csrc.ucsd.edu/input/csrc/proposals/CRTNProposal_version5.0.pdf