Mining Seismic Wavefields

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The Mining Seismic Wavefields project is a three-year research collaboration among SCEC seismologists at Stanford, USC, Caltech, and Georgia Tech who are funded under the NSF Geoinformatics program to develop and demonstrate new methods for seismological data mining of continuous waveforms. The premise of the project is that continuous and/or densely recorded data, coupled with high-performance computing and scalable algorithms, can greatly improve the detection of weak events that would go undetected using traditional methods. The project is based on seismic waveform similarity. This similarity may arise because different earthquakes occur near one another so that waves from them bear the same signature of interaction with the complex crust of the Earth. Waveform similarity may also arise because seismic sources are recorded at instruments close to one another. The Mining Seismic Wavefields project exploits both of these situations. In this talk I will give an overview of methods and show results for: (1) QTMatch for comprehensive template matching for Southern California, (2) Fingerprinting and Similarity Thresholding for uninformed data mining of long duration waveform datasets, (3) Dense array analysis of exotic seismic sources near the San Jacinto Fault, and (4) Dense array event detection in an urban setting using local coherence. An important part of the project is not only to develop these methods, but also to make them broadly available. Towards that end, we are distributing computer programs through GitHub and seismicity catalogs through seismological data centers. Data-intensive computing approaches, such as these, are being increasingly impactful in seismology – a trend we expect to continue as low-cost, capable sensor technology provides unparalleled spatial resolution of seismic wavefields. The work carried out under the Mining Seismic Wavefields project will help realize the full potential of seismic networks of the future, and in doing so will provide a much clearer view into earthquake processes.