In the next 30 years, California has a 99.7% chance of experiencing an earthquake of magnitude 6.7 or greater and a 50% chance of a magnitude 7.5 or greater. Although an earthquake of large magnitude and its aftershocks are expected to cause severe destruction and injuries, an earthquake early warning system (EEWS) can be used to execute automatic measures to mitigate expected damage at distant sites. Over the past four years, the California Integrated Seismic Network (CISN) has tested the real-time performance of three algorithms for EEW in California: τc-Pd, ElarmS, and Virtual Seismologist. During the next two years, the three semi-parallel processing threads will be merged to a single integrated system, CISN ShakeAlert. This summer under Maren Boese, a senior post doctoral scholar at California Institute of Technology, I had the opportunity to contribute to the development of τc-Pd, the algorithm Caltech is responsible for.

Because California experiences few earthquakes of large magnitude frequently, the testing of the τc-Pd algorithm has been limited to small and moderate sized earthquakes. To test the τc-Pd algorithm during a large earthquake, I developed a tool to demonstrate its performance during various large earthquake scenarios for Southern California. In addition to scenarios, it can also show the performance of τc-Pd during real-time earthquakes. The scenario I used as a basis for my tool was Geoffrey Ely's Elsinore Fault Mw 7.75- Scenario 1.

In the first weeks of my research, I became familiar with Matlab, the computing environment I used throughout the duration of the internship. During this process, I created the following image showing the available warning times to various locations in Southern California during the Elsinore Fault Scenario.
During the following weeks of my internship, I focused on the development of the demonstration tool. The tool shows the propagation of the primary and secondary body waves after an earthquake in real-time. It also displays the seismic stations with three seconds worth of data after they are triggered by the primary wave. Furthermore, it estimates the epicenter location and the predicted earthquake magnitude in real time. To achieve these predictions, I used time series analysis to estimate the magnitude and the τc-Pd's algorithm to estimate the epicenter location.

The tool's following still image displays the Elsinore Fault Scenario 10 seconds after the earthquake's initiation. The dashed line is the fault rupture, the pink triangles are seismic stations, and the cyan triangles are the stations that have 3 seconds of data following their triggering by a P-wave. The black lines are faults, the blue circle is the P-wave, and the red circle is the S-wave. The yellow star is the real epicenter of the earthquake while the black outline of the star is the estimated epicenter. The time on the bottom left corner (59.1 s) is the amount of time before the S-wave arrives to the user location (USC).
For the remaining weeks of my internship, I will implement predicted peak-time ground motion parameters into the tool. The demonstration tool will be used in the future by Maren Boese to visualize the performance of the $\tau_c$-Pd algorithm with other scenarios and during recent earthquakes.