# FAULT EVOLUTION AND EARTHQUAKES: A FINITE ELEMENT STUDY

Qingsong Li

Dr. Mian Liu, Dissertation Supervisor

## ABSTRACT

The New Madrid Seismic Zone (NMSZ) in central United States is a good example of intraplate seismicity, which cannot be readily explained by the plate tectonics theory and remains poorly understood. I have developed a 3D FE model to simulate stress evolution in the NMSZ and surrounding regions. I find that, following a large earthquake, intraplate seismic zones tend to stay in a Coulomb stress shadow for thousands of years, while significant amount of stress and strain energy relieved from the large earthquakes may migrate to and remain within the surrounding crust. The results are consistent with seismicity in the NMSZ region following the 1811-1812 large events.

To investigate fault evolution and seismicity in plate boundary zone, I have built a 3D dynamic model for the entire San Andreas Fault (SAF) system in California, with the first-order characters of its surface geometry. The results indicate that the geometry of the SAF may be the primary cause of the observed along-strike variation of slip rate, stress states, and seismicity. In particular, the Big Bend of the SAF causes the scattered seismicity in southern California and may have facilitated the development of the San Jacinto Fault (SJF) and other active faults there. I have explored the dynamic interactions between the SAF and SJF in the model and found that the initiation of the SJF tends to decrease fault slip rate on the southernmost SAF and focus strain energy in the Mojave Desert and along the East California Shear Zone. These results are consistent with the spatial distribution of earthquakes in southern California, and provide some insights into evolution of fault systems in the plate boundary zone as it continuously seeks the optimal way to accommodate the relative plate motion.