SCEC Field Notes Article: "Collaborative Research: Rupture propagation and slip at complex fault intersections: The San Andreas - San Jacinto - Cucamonga fault intersection in Cajon Pass."

Bryan Gulotta, Haverford College
Dr. David Oglesby, University of California Riverside
Dr. James Dolan, University of Southern California

There are few geologic regions as pertinent in the study of complex fault behavior as the San Andreas – San Jacinto – Cucamonga fault intersection in Cajon Pass. The San Jacinto and San Andreas strike-slip faults are nearly parallel in the Cajon Pass due to the former's asymptotic approach to the latter. Both lie on the hanging wall of the undercutting Cucamonga fault, a thrust fault responsible for the significant mountain building seen in the region. Despite it's geologic significance, few specifics are known about the geometry of these three faults at depth. Therefore, little is understood about the behavior of these faults with respect to the regional stress field.

This project utilizes finite-element analysis to model the faults of Cajon Pass. CUBIT, a modeling program created by Sandia National Laboratories, is used to create a block representative of the desired fault geometry (Figure 1). The block is subsequently divided into *elements*, small volumes of equivalent size that divide the block into a fine 3-dimensional mesh. For reasons of spatial complexity and computational efficiency, the model used in this project is divided into tetrahedral pyramids (Figure 2).

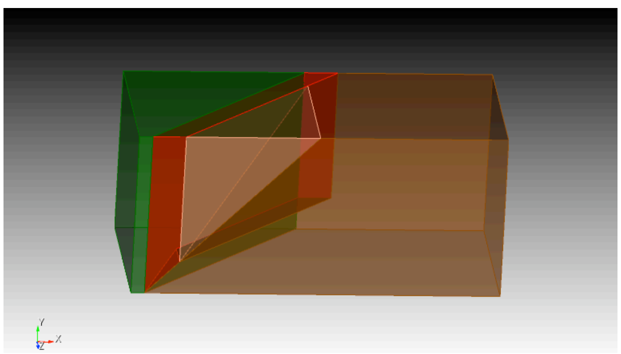
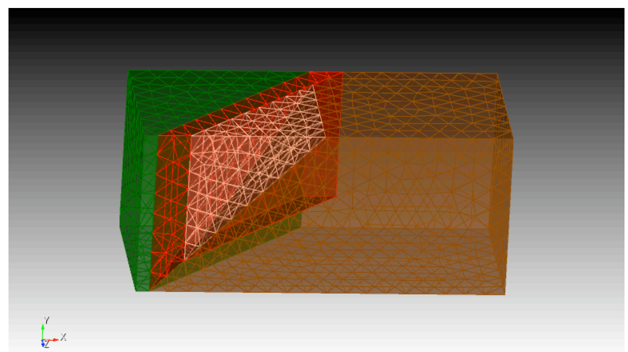


Figure 1 - Geometric Model of SA-SJ-CU fault intersection, unmeshed.



The model is outputted using a combination of Python and CUBIT's proprietary language. The resulting file is then parsed with a C++ script to create an input file for FaultMod, a program created by Invisible Software for finite element analysis of fault systems. FaultMod accepts input of tectonic conditions that are then exerted on the model. The movement of each node in the model is tracked and recorded at various time steps, then exported as a text file that can be represented visually with MatLab.

Information gleaned from this project will be crucial for the prediction of significant tectonic events in Cajon Pass. A better understanding of the behavior of these faults could have major societal implications. The results could save lives, prevent economic loss resulting from earthquake destruction, and aid in future development in Southern California. A better understanding of the behavior of these faults could have major societal implications.

Despite the importance of this study on the local scale, the progression of geologic understanding that will result from proper analysis of the Cajon Pass could be of even greater benefit. While it is impossible to arrive at a concrete set of axioms for the behavior of complex fault systems under pressure, results of this analysis will allow future studies to approach tectonic environments with greater detail and better understanding.

The application of CUBIT to geologic features also provides a great opportunity for future research. Since any geometric configuration of faults, folds, and bedding can be represented by CUBIT, every area of geologic interest can be recreated, meshed, and imported to FaultMod for analysis. This is an invaluable tool for any project aiming to
u
n
d
e
r
s
t
a
n
d