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Motivation or Objective:

Understanding the important material effects in a 2-D model will give insight into the necessary effects that should be used in a 3-D model. This will help create better models of Friction Stir Welding that will have the capability to optimize the input parameters in a quick and cost effective manner.

Background:

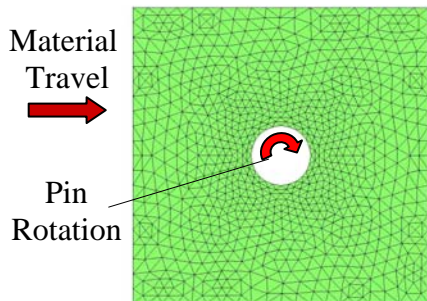
Cornell University has developed a finite element code that has been used in other large deformation applications such as metal rolling. It currently is being modified to model friction stir welding at steady state conditions. The code has the capability of modeling work hardening, thermo softening, and visco-plastic material, which will soon be an elastic visco-plastic model.

Results and discussion:

The predicted results from a wide variety of input parameters have been generated by the 2-D model and are shown below.

Initial Eulerian Mesh

2-D Cross section Under the Pin

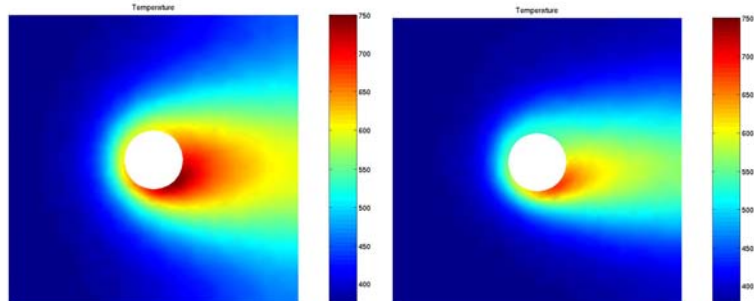


Viewing Rectangle = 1 by 1 inch
Pin Diameter = .4 inch

Changing Feed Rate

Low = 2 in/min

High = 6 in/min

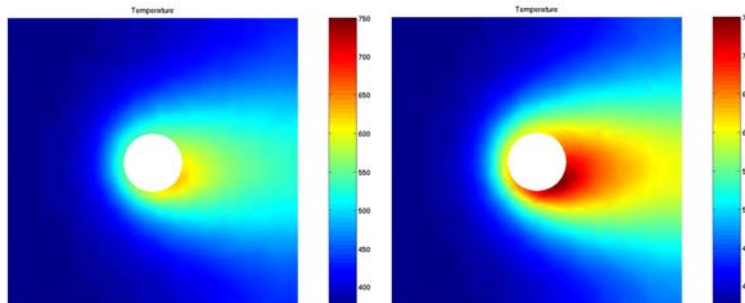


Temperature drop by ~ 50 K

Work Hardening Effects

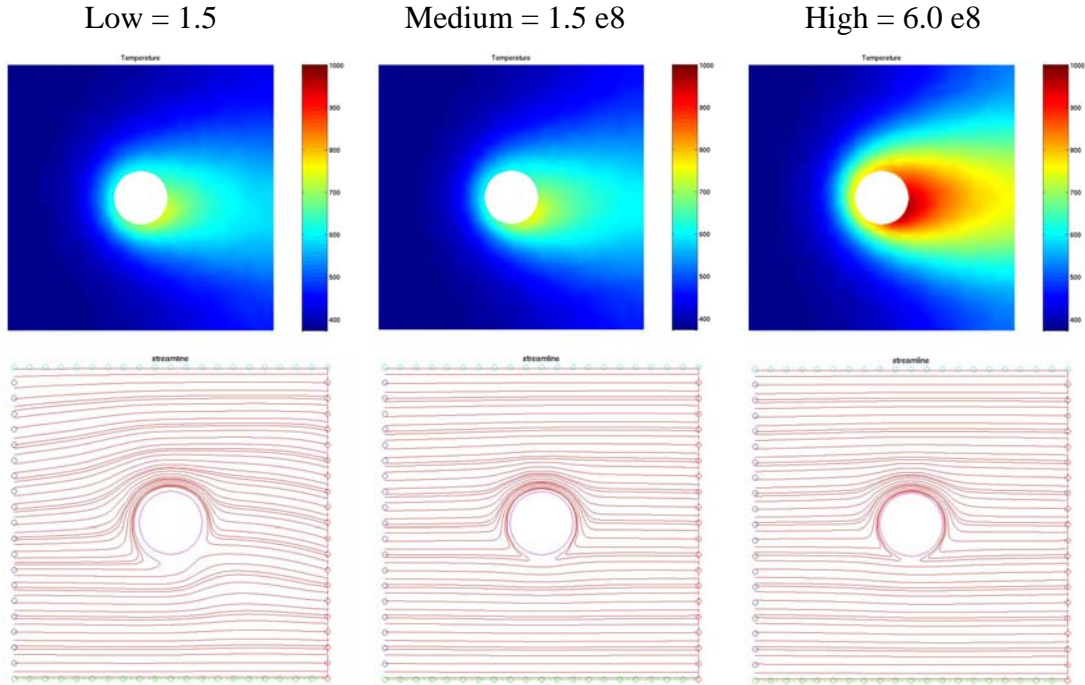
No Work Hardening

With Work Hardening



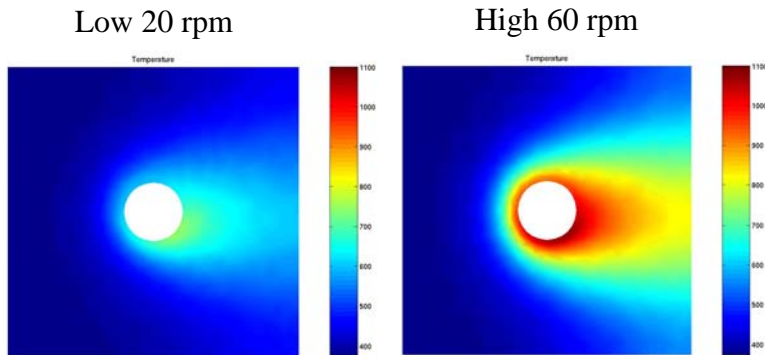
Increases the Max Temperature by 100 K

Initial Hardness Parameter



Temperature increases exponentially with the initial hardness parameter

Changing RPM



Max Temperature increased by ~ 300 K

Experimental approach:

Plates have been instrumented with thermocouples in order to validate the models temperature field. More validation test will be run in the future.

