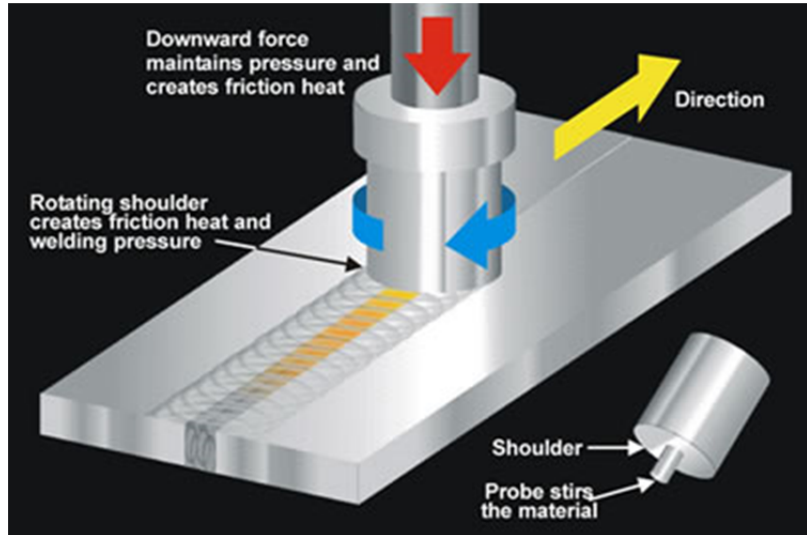


Friction Stir Welding Control Lab

Friction Stir Welding is a joining process that plasticizes and stirs adjacent metal layers together. This is accomplished by rotating a shaft with a specialized bit that creates a uniform stir zone. It is desirable to maintain the bottom tip of the rotating shaft at a specified temperature, especially during the startup and initial traverse of the weld. At steady state operating conditions the top of the shaft is cooled as the friction stir process generates heat.

You've been asked to consider ways to better control tip temperature during welding operations. Your objective is to maintain a temperature at the bottom end of the rotating weld tool. The following should be considered in developing a controller:



Modeling

- Simplified First Principles Model
- Various Empirical Model Forms such as FOPDT, ARX, FIR, State Space

Controller Design

- Maintain a temperature setpoint at the tool tip
- Investigate the use of the following disturbance or manipulated variables
 - Forward speed of the weld
 - Torque, rotational speed, or power (one of these)
 - Downward force or axial position (one of these)
- Implement a PID controller in simulation
- Compare the performance of the PID controller to Model Predictive Control (MPC)

Helpful References and Resources

http://en.wikipedia.org/wiki/Friction_stir_welding

<http://youtu.be/rim0wJxZ-O8>

<http://liu.diva-portal.org/smash/record.jsf?pid=diva2:535544&rvn=4>