Microwire Welder

Designed for the Combustion and Solar Energy Lab
Directed by Dr. Fletcher Miller

SDSU San Diego State University

SOLAR SDSU ENGINEERING

AZTEC MICROWIRE WELDING

Project Overview

The Microwire Welder enables precise micro-actuation alignment for both fabrication and repair of wires on the micron scale. Fine-gauge thermocouples are fabricated by utilizing a capacitive discharge to electrically fuse two metal wires at a butt-junction. Through a user interface, the discharge can be controlled to define the following parameters: Starting Current, Stopping Current, Pulse Time, and Pulse Shape. Additionally, hot-wire anemometers are repaired by aligning a wire to the prongs for easy and consistent soldering. This device aims to function without a lot of trial and error or user experience.

Acknowledgments

Enclosure
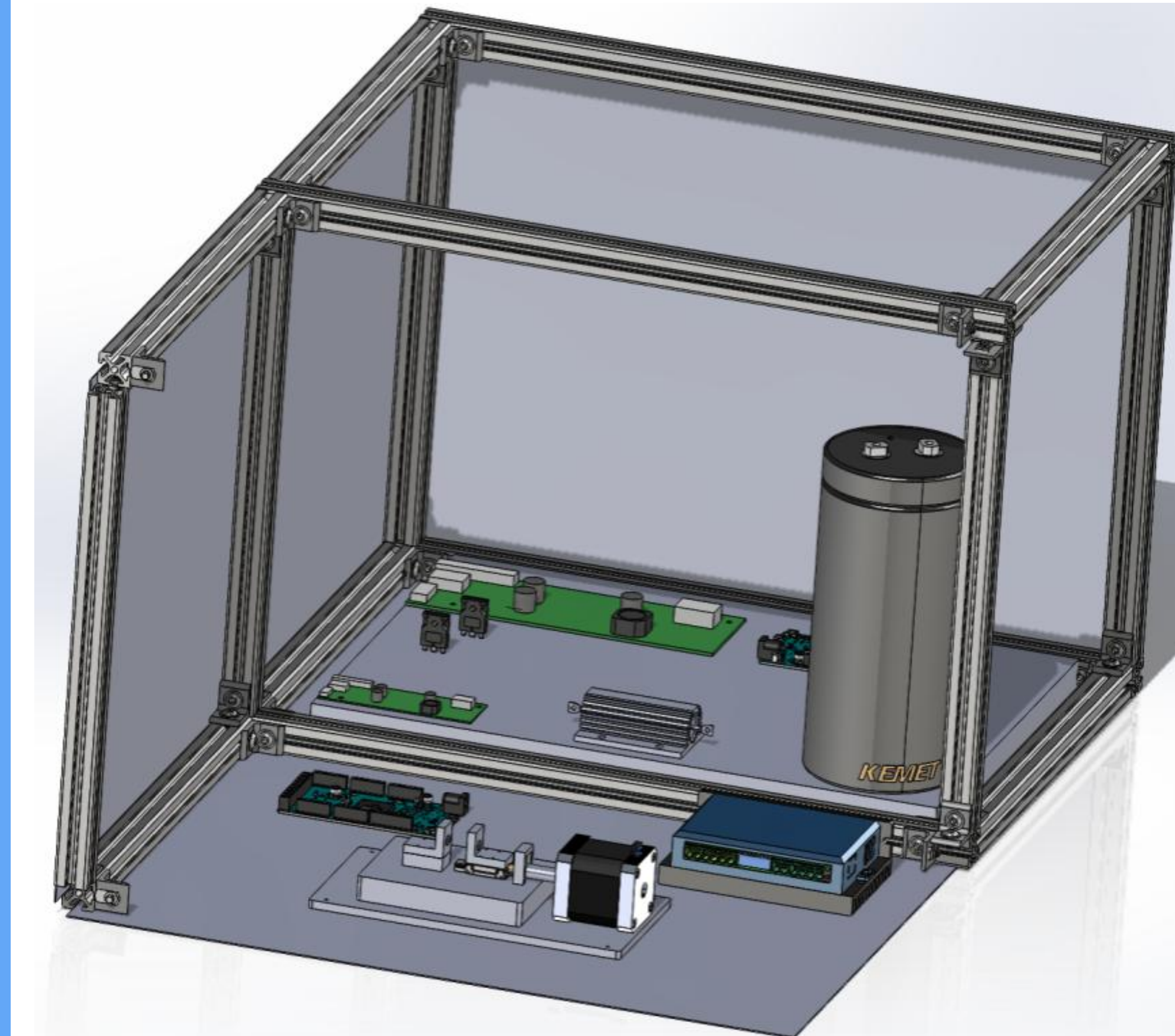
Micro-Actuation
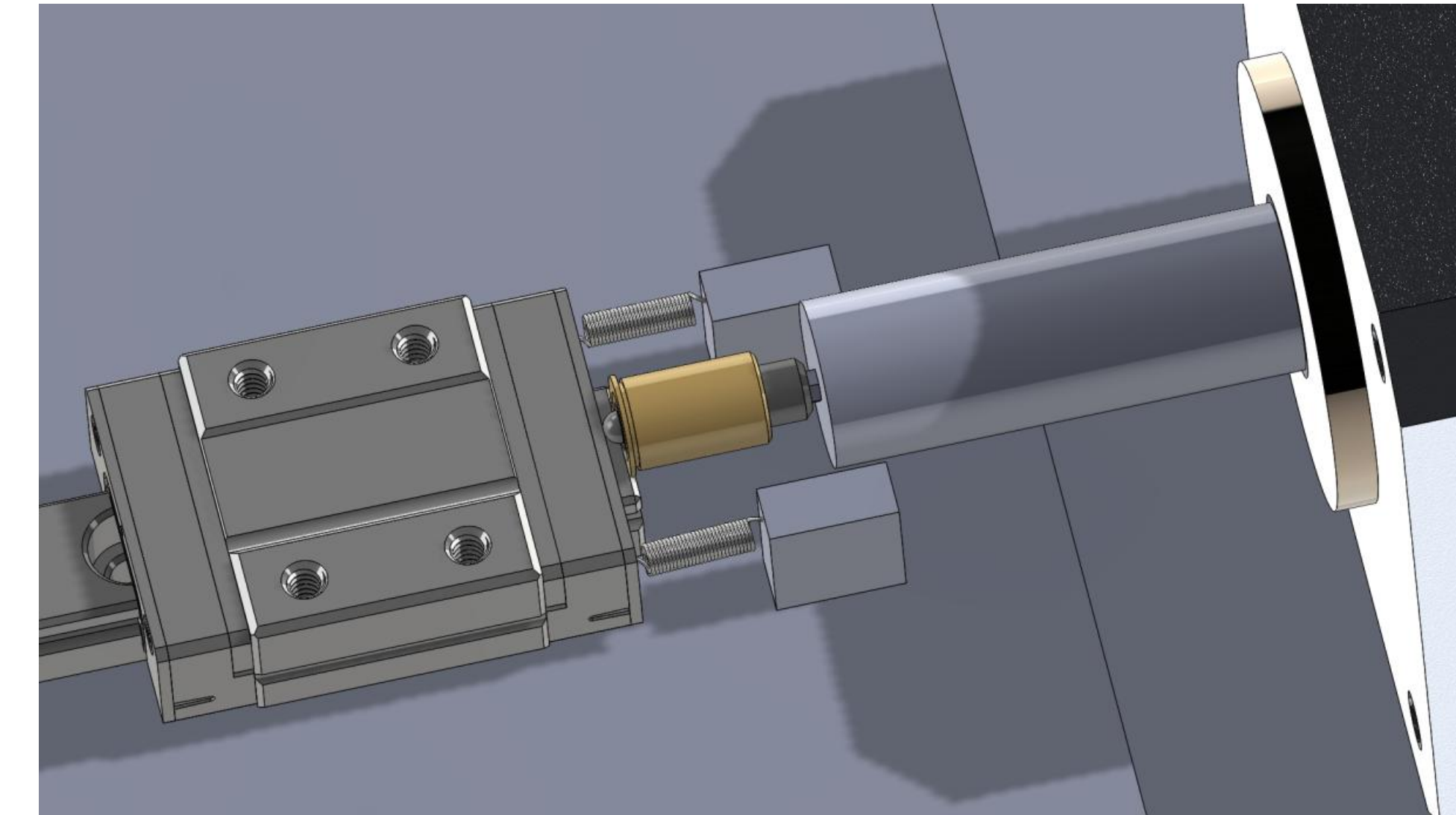
-Lead screw driven by stepper motor pushing on carriage
-Springs in tension for carriage return
-1.8 degree step angle on the motor and 254 TPI gives 0.5 micron steps
-Additional precision from micro stepper driver

Team Members

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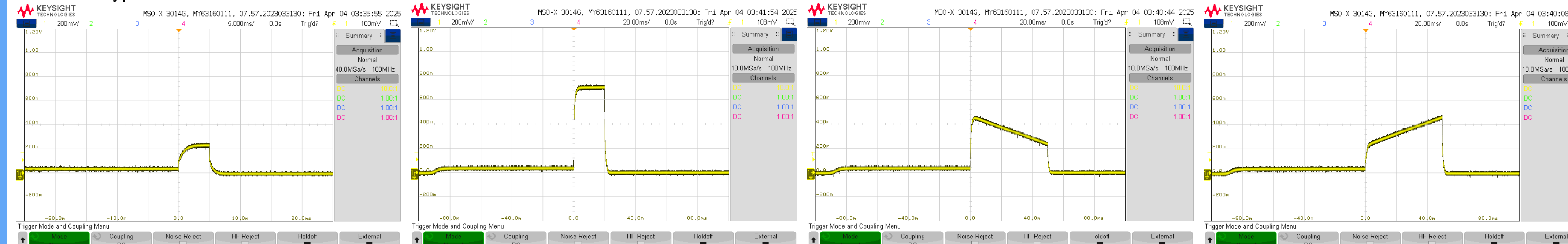
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Controllable Current Source

Thermocouples are unique in diameter and material type. A controllable current source allows for all sizes and types to be welded.

From left to right, current examples are shown for: (5A for 5ms), (15A for 20ms), (10A to 5A for 50ms), and (5A to 10A for 50ms)

Thermocouple Operation

-MATLAB User Interface paired with an Arduino IDE
-Allows for a Linear or Exponential Current Pulses
-User Changeable Parameters for: Starting Current, Stopping Current, and Weld Time

-Welding Parameters are sent to an Arduino Due
-The DAC Output is utilized to set both the current limit, as well as turning on the MOSFET, initializing the Welding Discharge

0.33F Capacitor

-Two 1x10 Screw Terminals utilized to allow external connections for both large components, as well as high power components.
-The "heart" for all of the circuitry

-A capacitive discharge is sent from the red wire, through the thermocouple junction, and out through the black wire, fusing the two metal wires together