

Correlating Large Sets of Experimental Data of a TIG Weld with a High Resolution Computational Weld Mechanics Model

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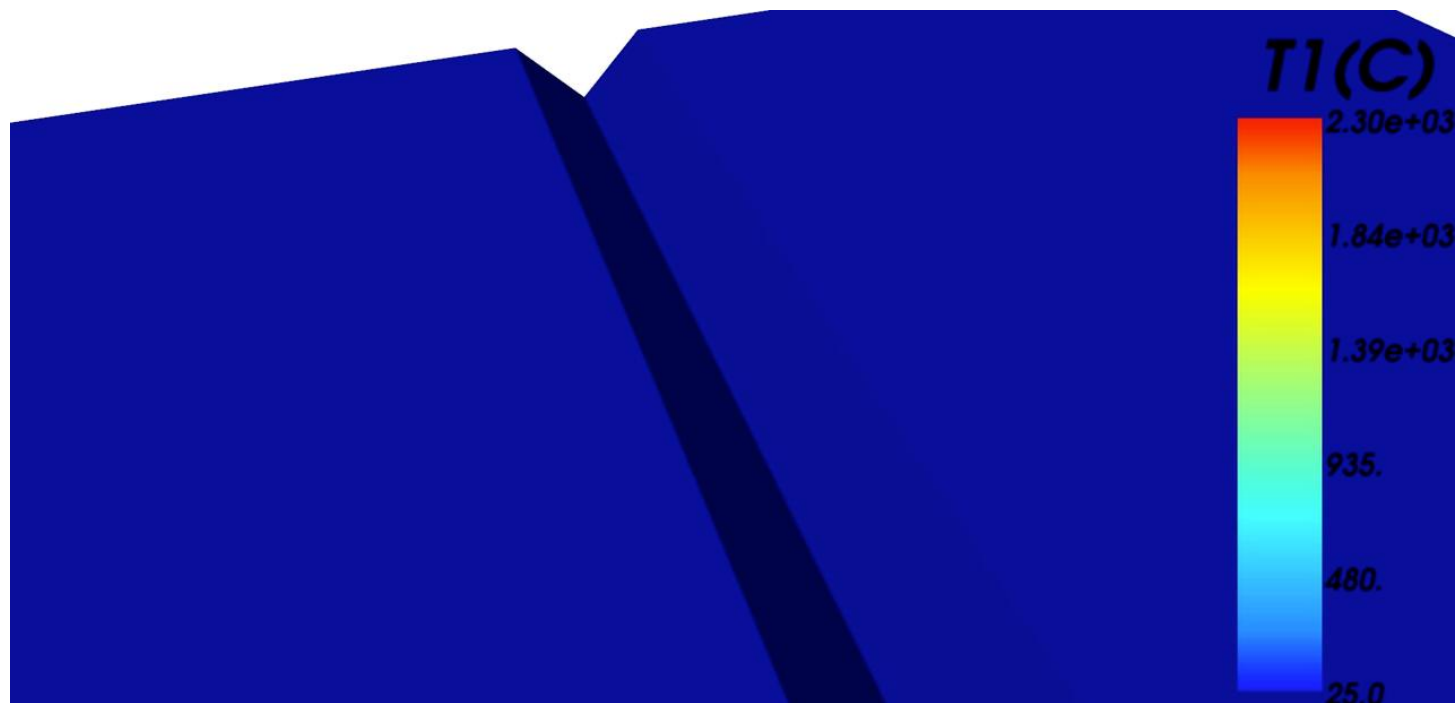
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Welding Paramaters

Parameters	values
Arc voltage (V)	14-14.9
Arc current (A)	150
Electrode diameter	1/8"
Arc length(mm)	1.5
Travel speed (mm/s)	0.85 -1
Argon gas (m ³ /s) and Helium (50% : 50%)- 30cfh	30CFH
Arc efficiency <small>Eisazadeh et al 2015, Journal of material processing Technology</small>	80%
Material	1018 steel

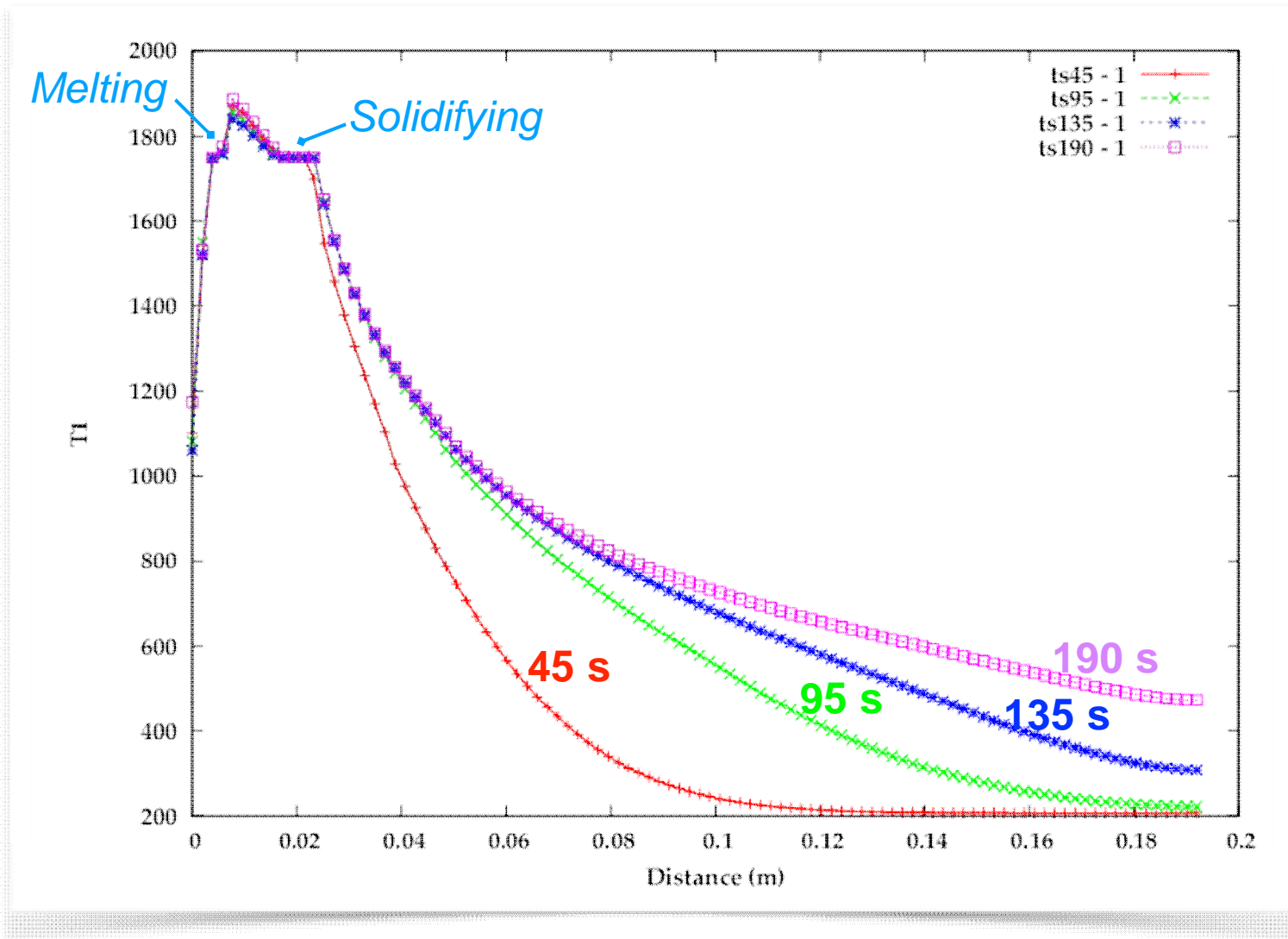
- 300 X 300 x 6.35 mm plate
- Total Weld bead length: 270 mm
- Time to complete the weld: 280
sec.
- Speed: $280/270 = 1.04$ mm/sec.
- Filler ER 7052
- Wire 1/16"
- GTAW

Weld Heat Source Model with Weaving



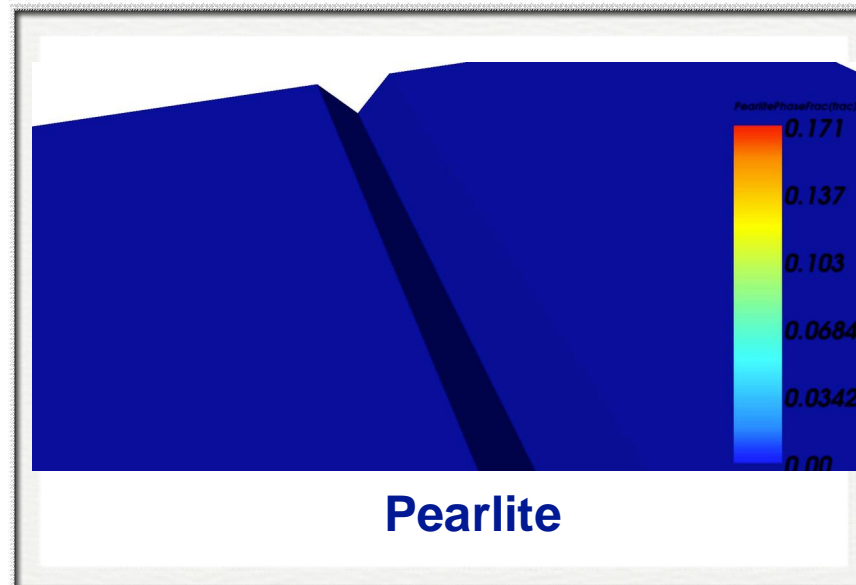
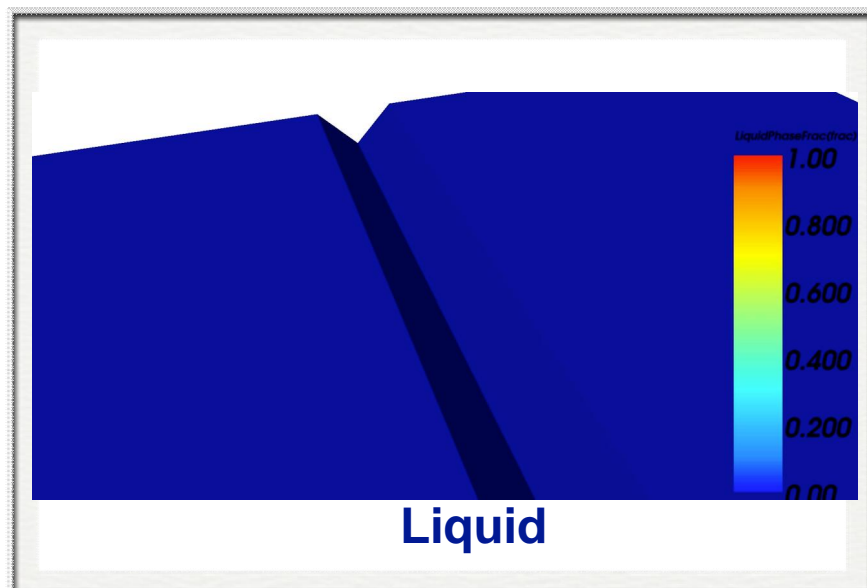
This weld heat source model is a function of arc thermal flux, arc pressure, filler metal mass flux, surface tension & gravity. 0.5 mm element size.

Temperature Kelvin vs Distance Along Weld Line

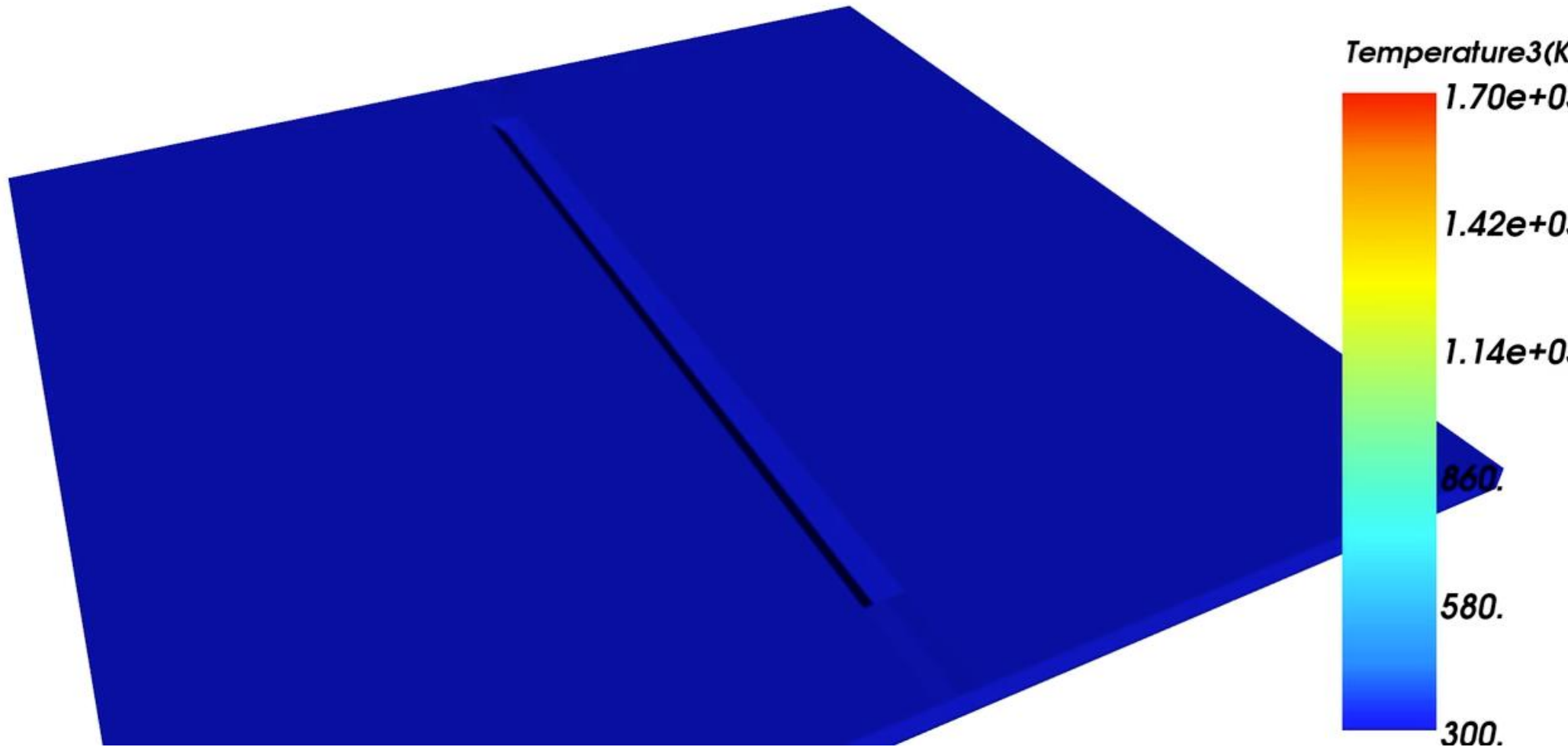


The red line shows temperature 45 s after the weld started, green 95 s, blue 135 s and mauve 190 s. The melting point is 1750 K. The flats on either side of the peak are due to the latent heat of solidification.

Transient Microstructure Phase Fractions

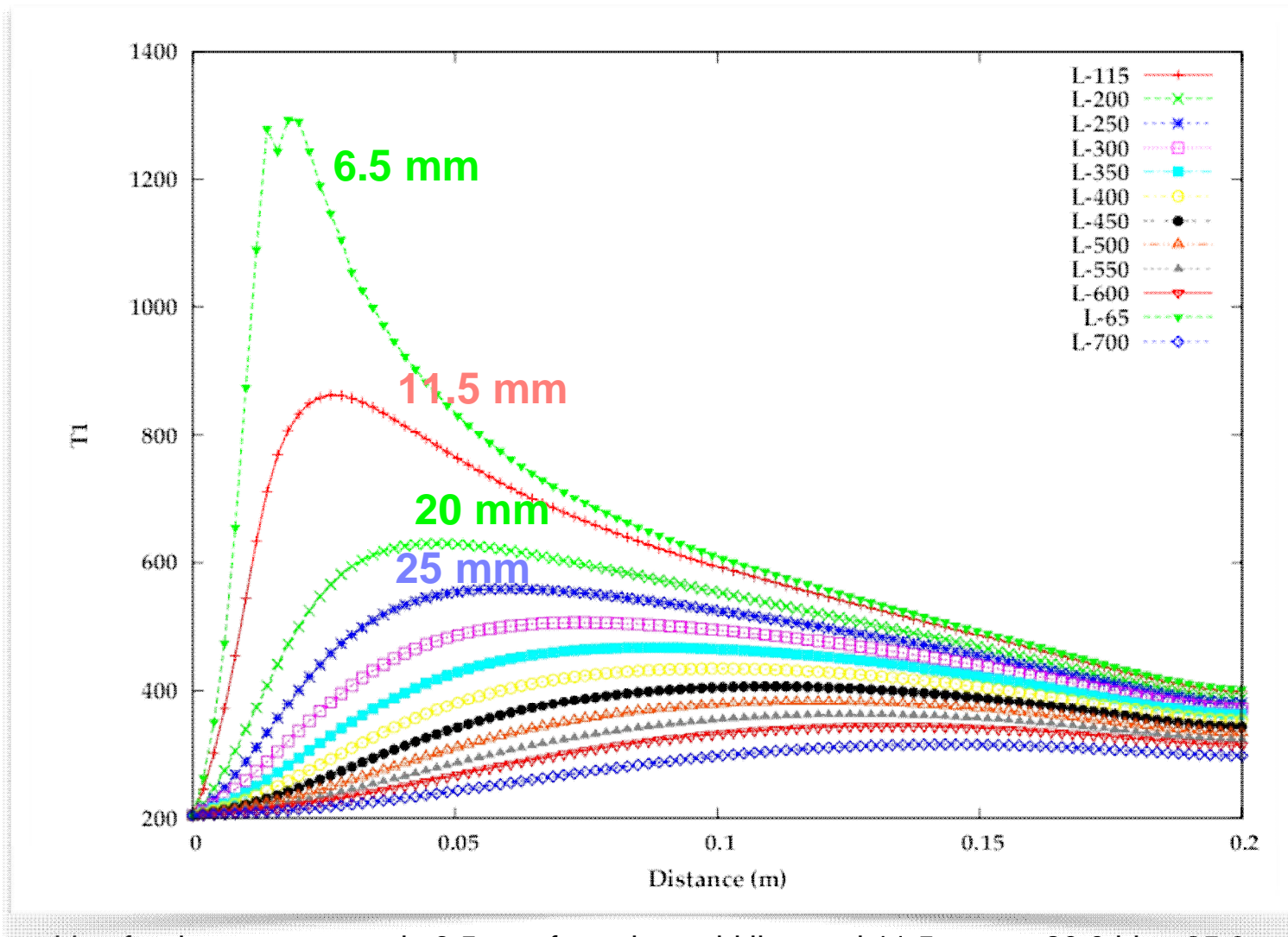


Transient Global Temperature Field



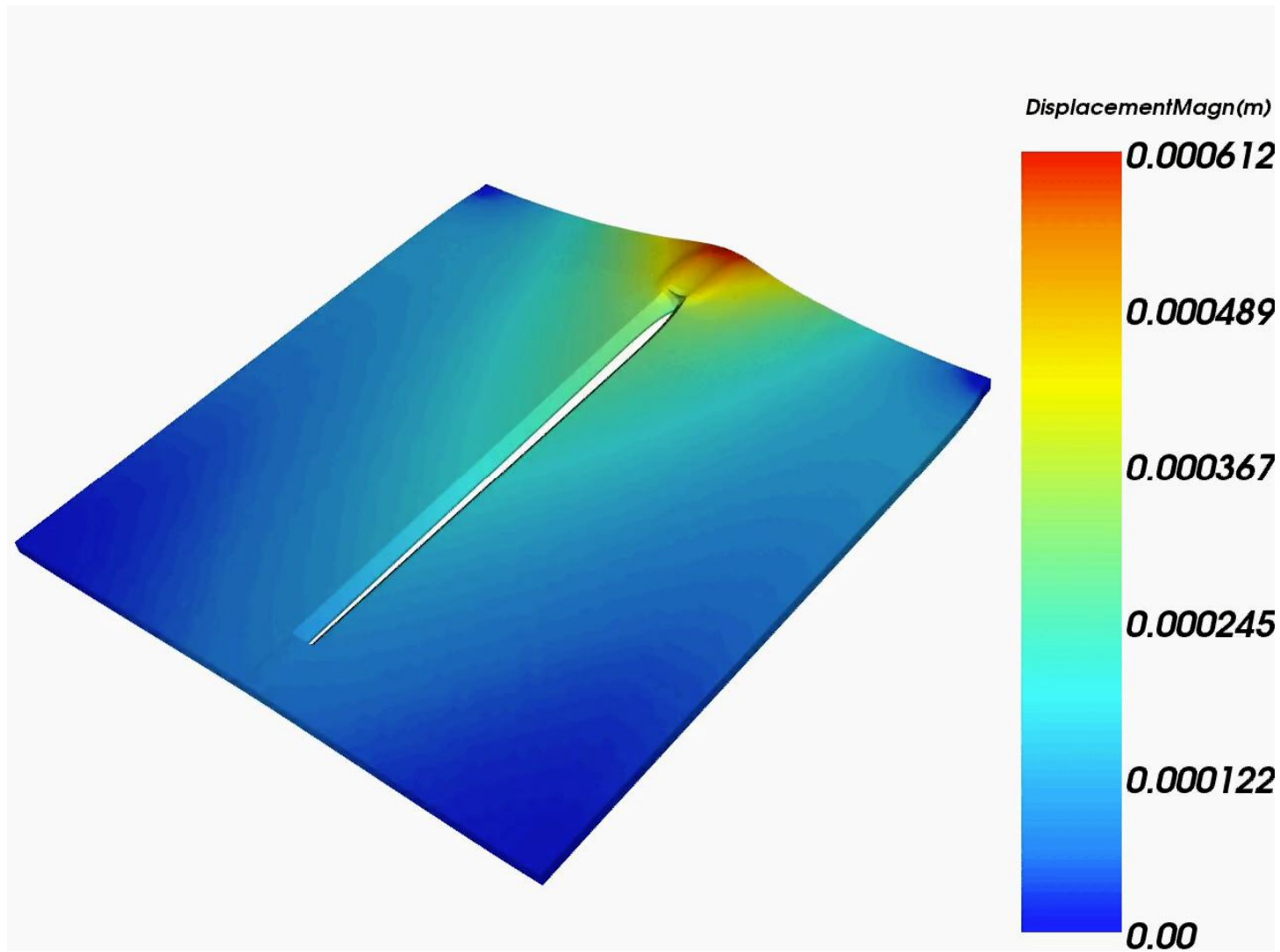
The transient temperature in 0.6 s time steps in the complete structure is shown. Note that the arc is stopped for 10 s in the middle of the weld.

Temperature vs Distance on Lines Parallel to the Weld Line



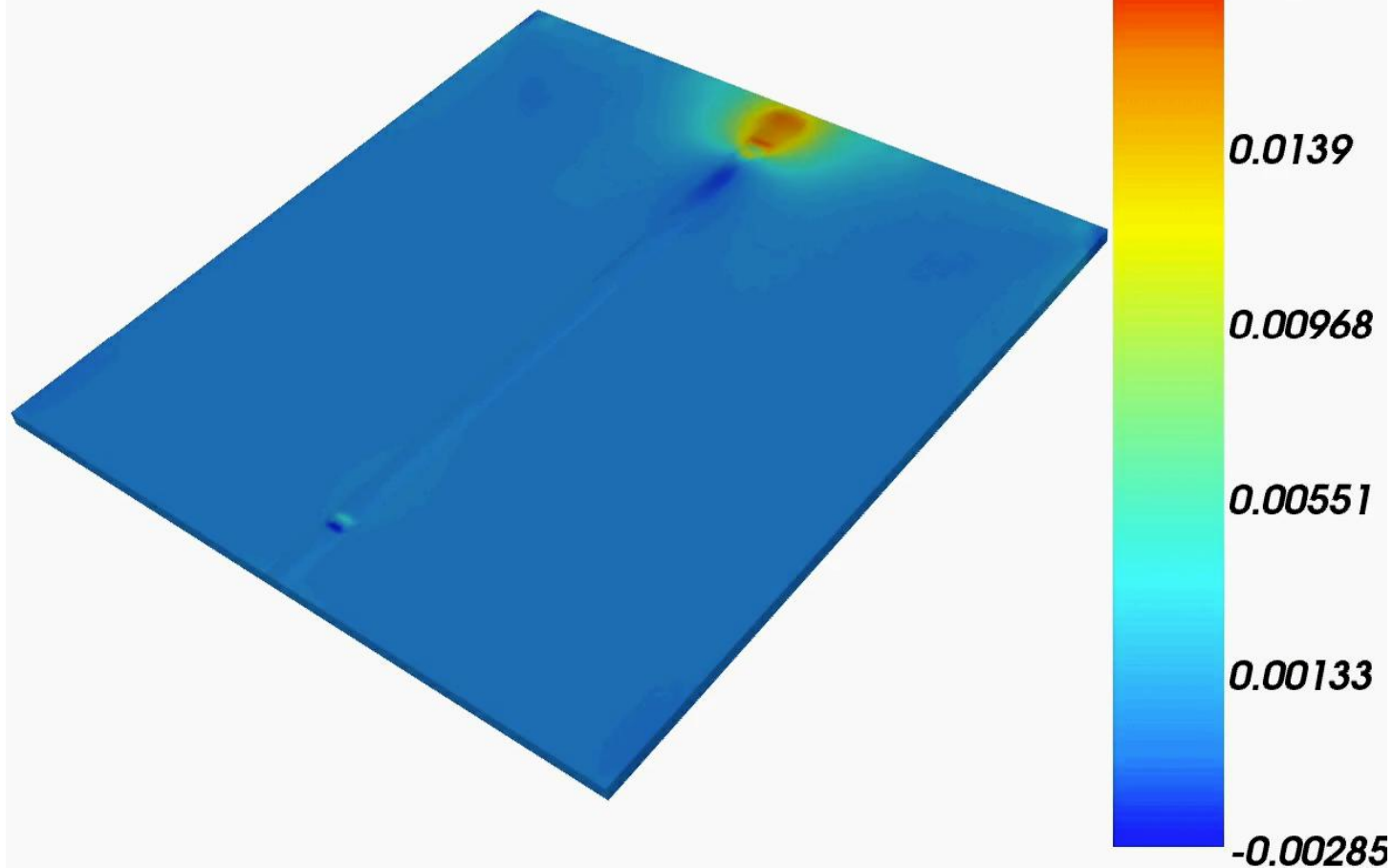
Line for the green curve is 6.5 mm from the weld line, red 11.5, green 20.0 blue 25.0, mauve 35.0, light blue 35.0, yellow 40.0. The oscillation at the peak is due to the arc weaving.

Transient Global Displacement Field



Transient Global Longitudinal Strain Component to Compare to DIC Measured Longitudinal Strain

The analysis includes cool down after completing the weld. The arc is stopped for 10 s to change electrodes in the middle of the weld. Note change when clamps are released at the end of the analysis.



Transient Global Transverse Strain Component to Compare to DIC Measured Transverse Strain

The analysis includes cool down after completing the weld. The arc is stopped for 10 s to change electrodes in the middle of the weld. Note change when clamps are released at the end of the analysis.

