Numerical simulation of pulsed TIG welding
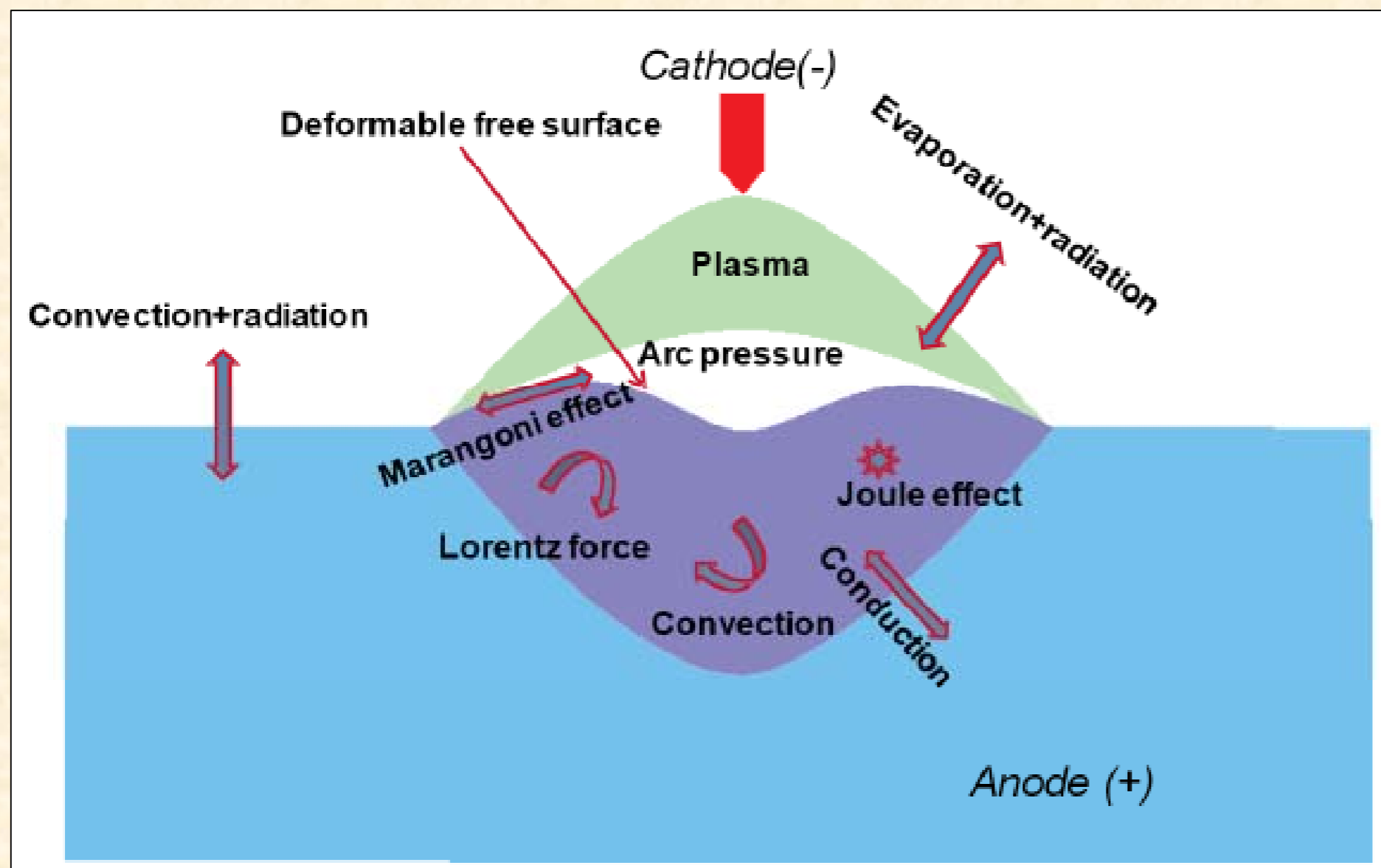
Partial and full penetration

A.Traidia, F.Roger, E.Guyot
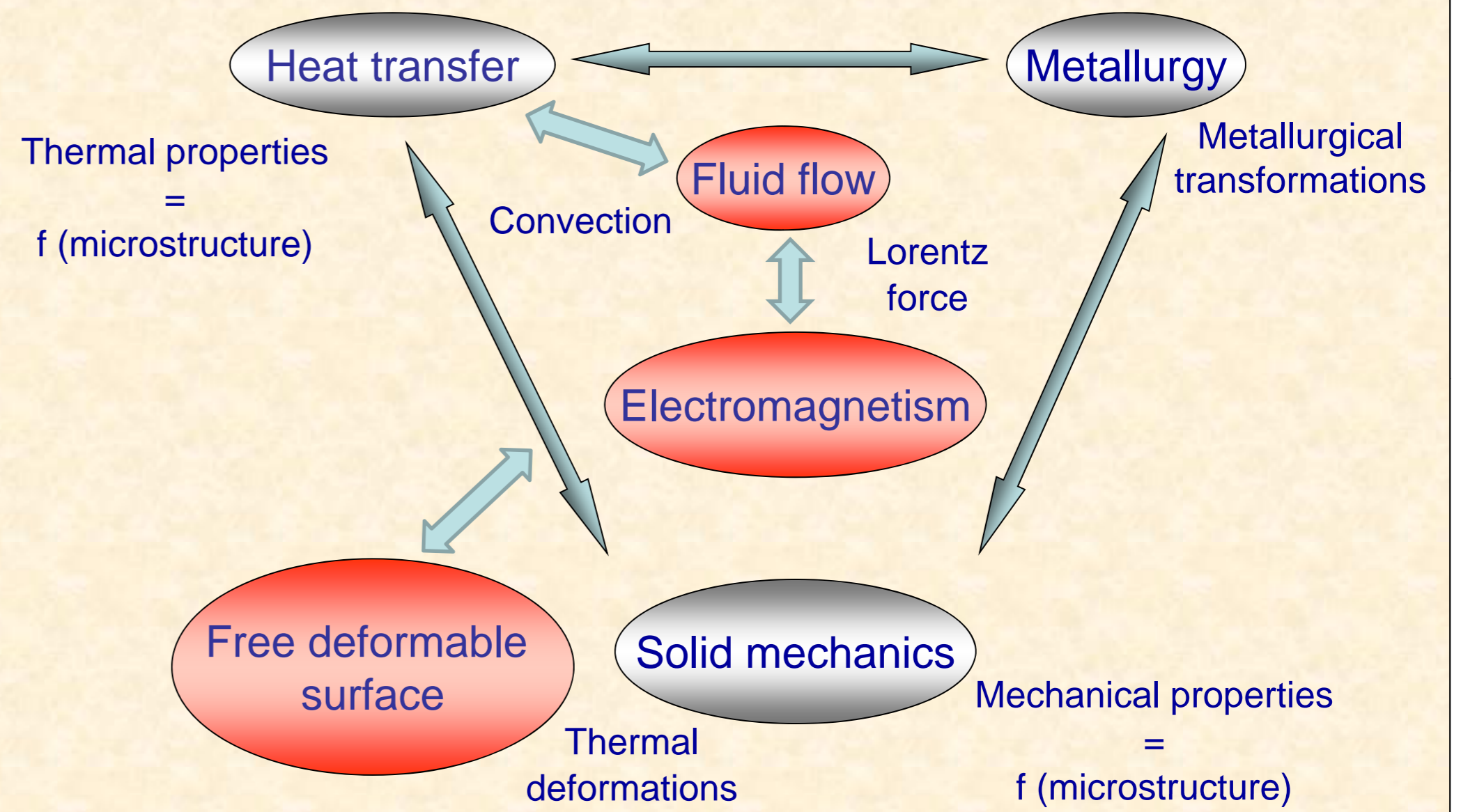
A highly coupled multiphysics problem

Arc welding - main phenomena


Multiphysics coupling

## A transient multiphysics model with strong coupling

Assumptions

- The study is restricted to GTA spot welding on low sulfur stainless steel, then we use an axisymmetric coordinate system

- The flow is laminar and incompressible due to the small size of the weld Pool

- The thermal gradient of surface tension is temperature dependent, and the latent heat of fusion is taken into account

- The magnetic field is time dependent and not a superposition of the top and bottom stationary solutions

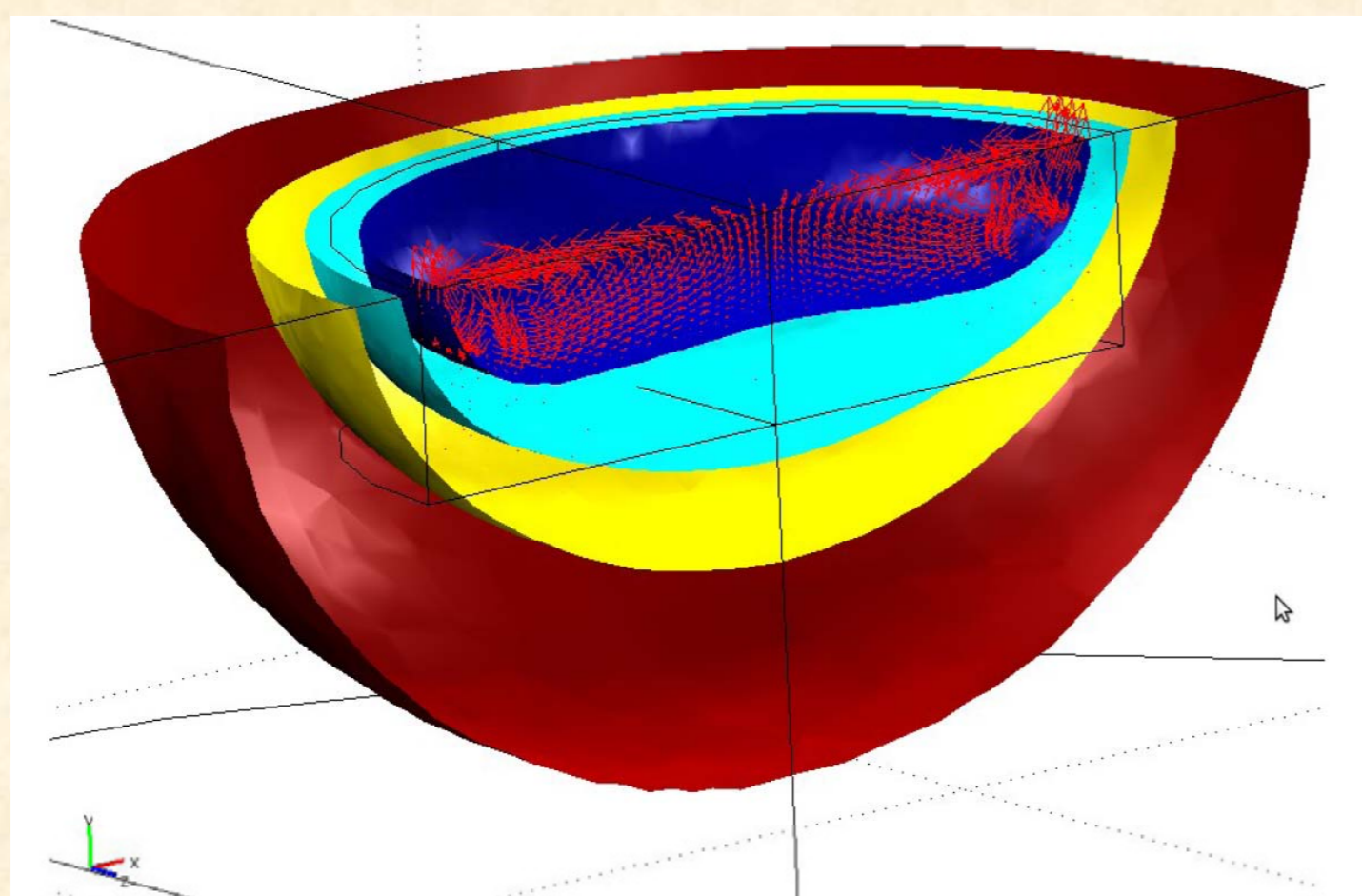- The free surface of the weld pool is deformable

Results

Evolution of weld pool during heating
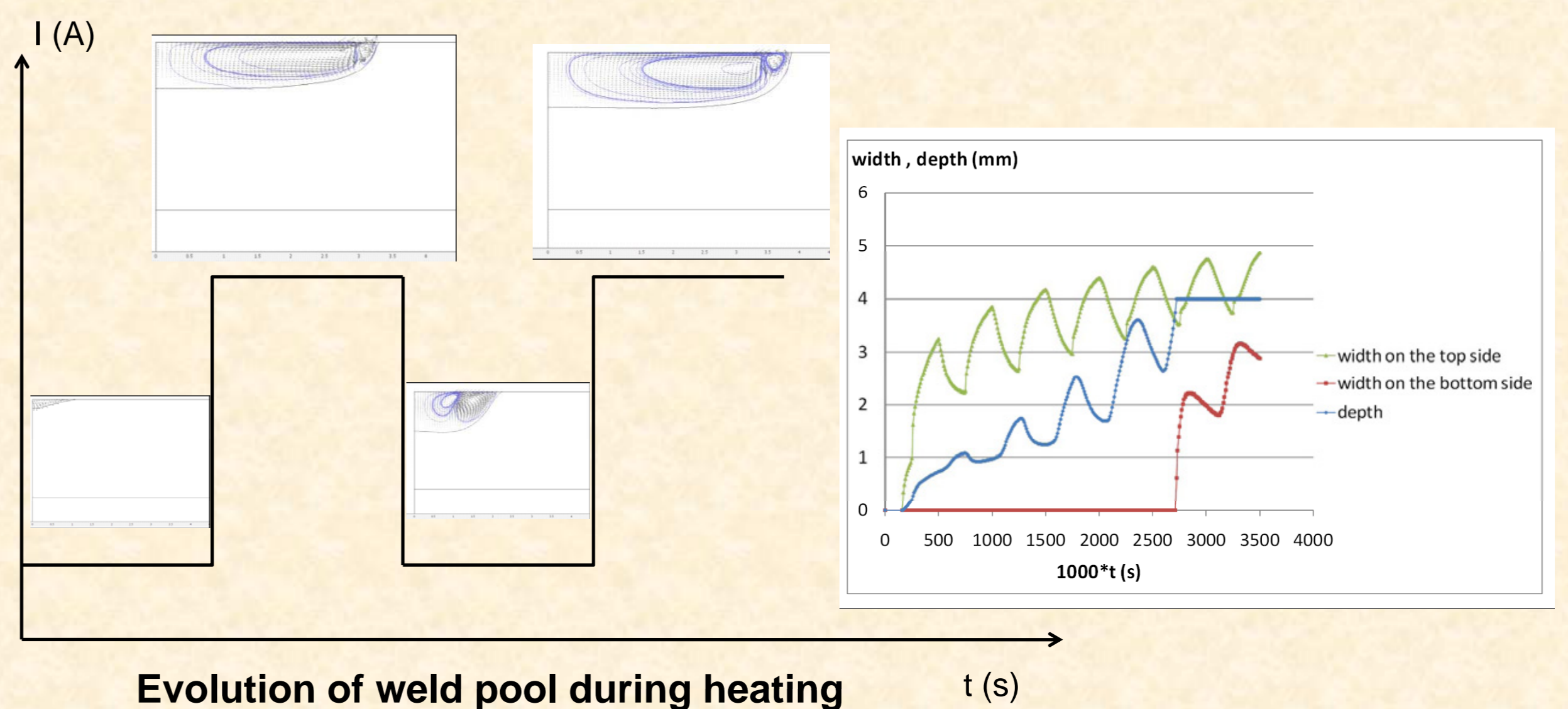
Full penetration, free surface and three dimensional representation
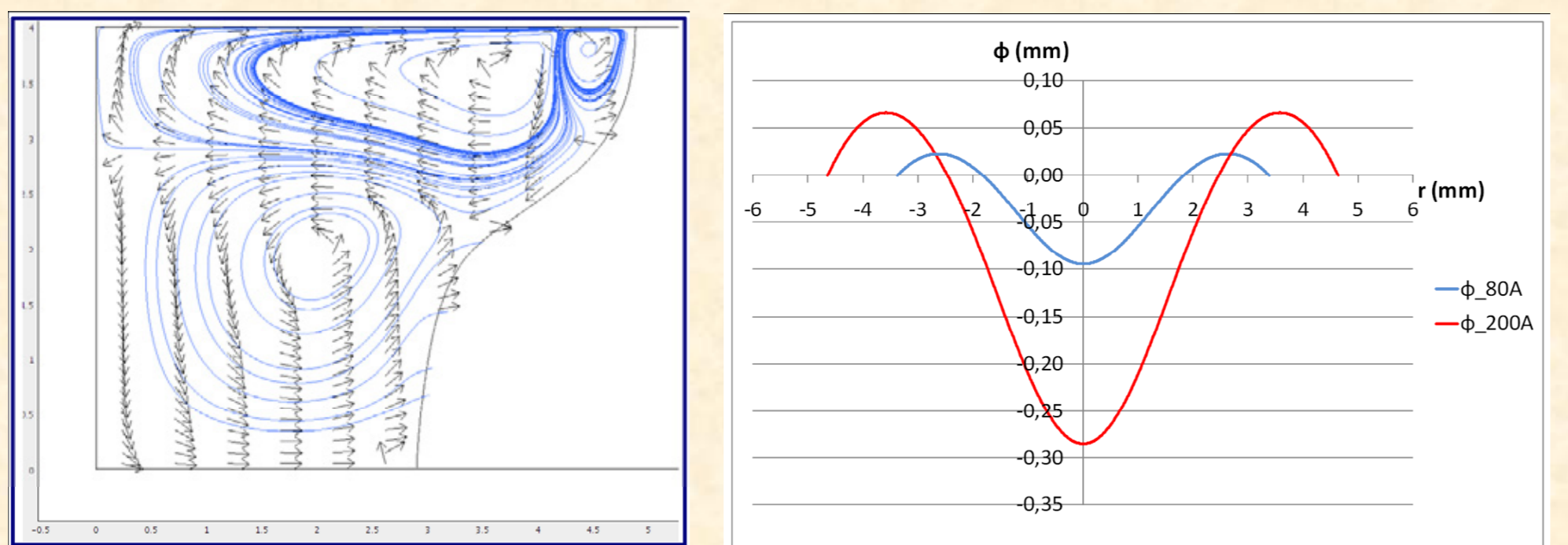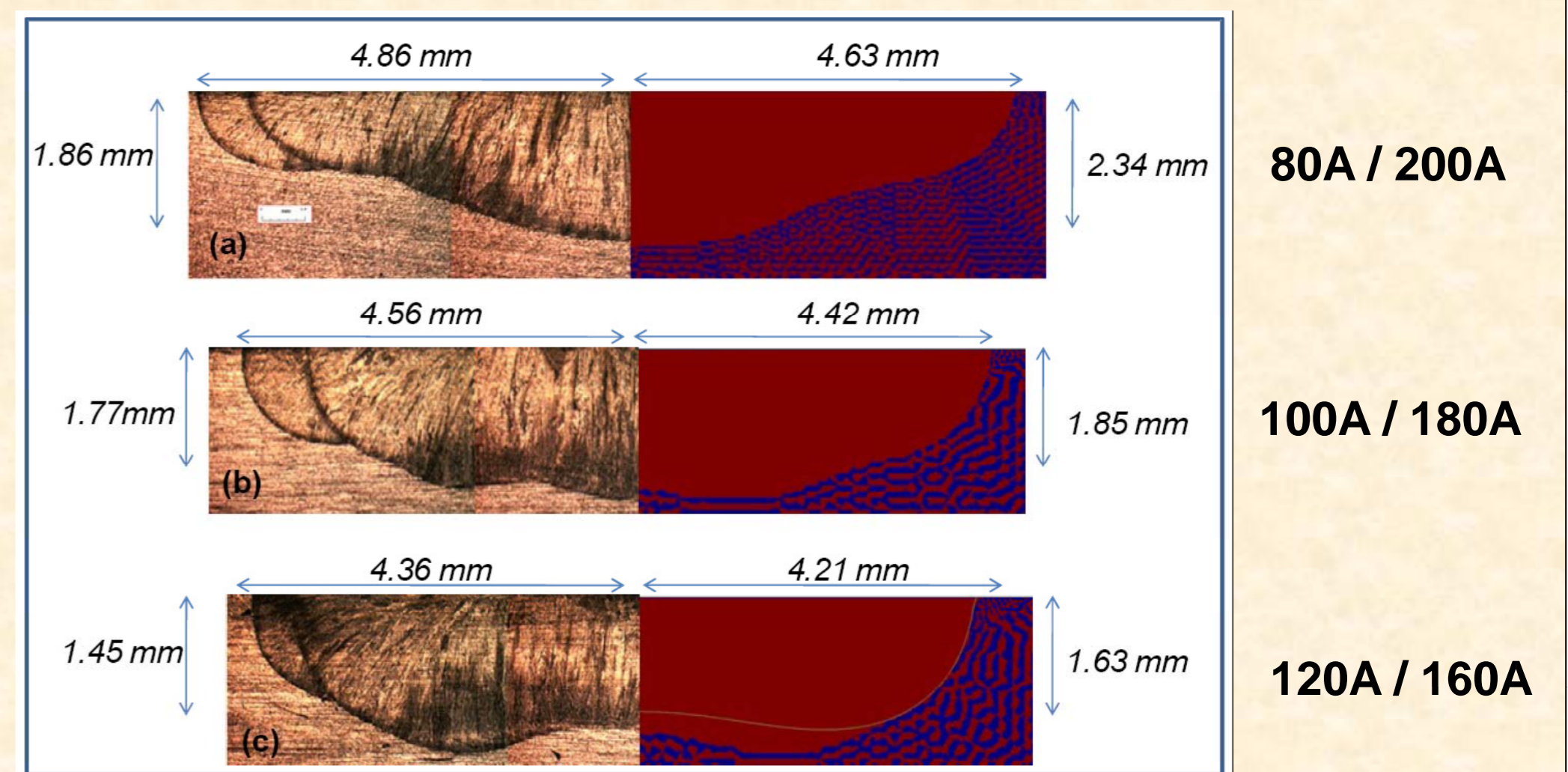

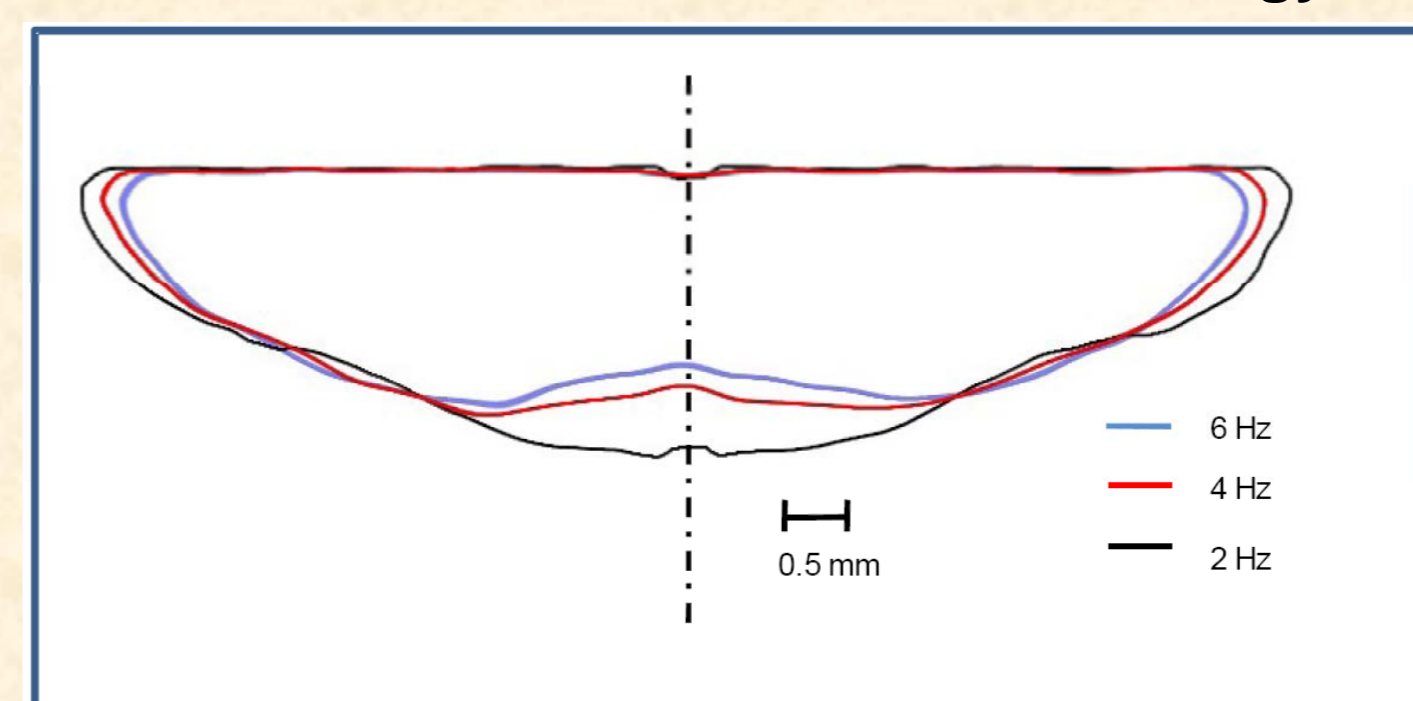Fully penetrated weld pool   Free surfaces at top and bottom times

Weld pool and some isothermal lines at bottom time

For a given energy, how to choose the pulsed current parameters ?

4.86 mm / 4.63 mm, 1.86 mm / 2.34 mm	80A / 200A
4.56 mm / 4.42 mm, 1.77mm / 1.85 mm	100A / 180A
4.36 mm / 4.21 mm, 1.45 mm / 1.63 mm	120A / 160A

Influence of current ratio at constant energy

80A / 200A
→2Hz
→4Hz
→6Hz

Influence of pulse frequency