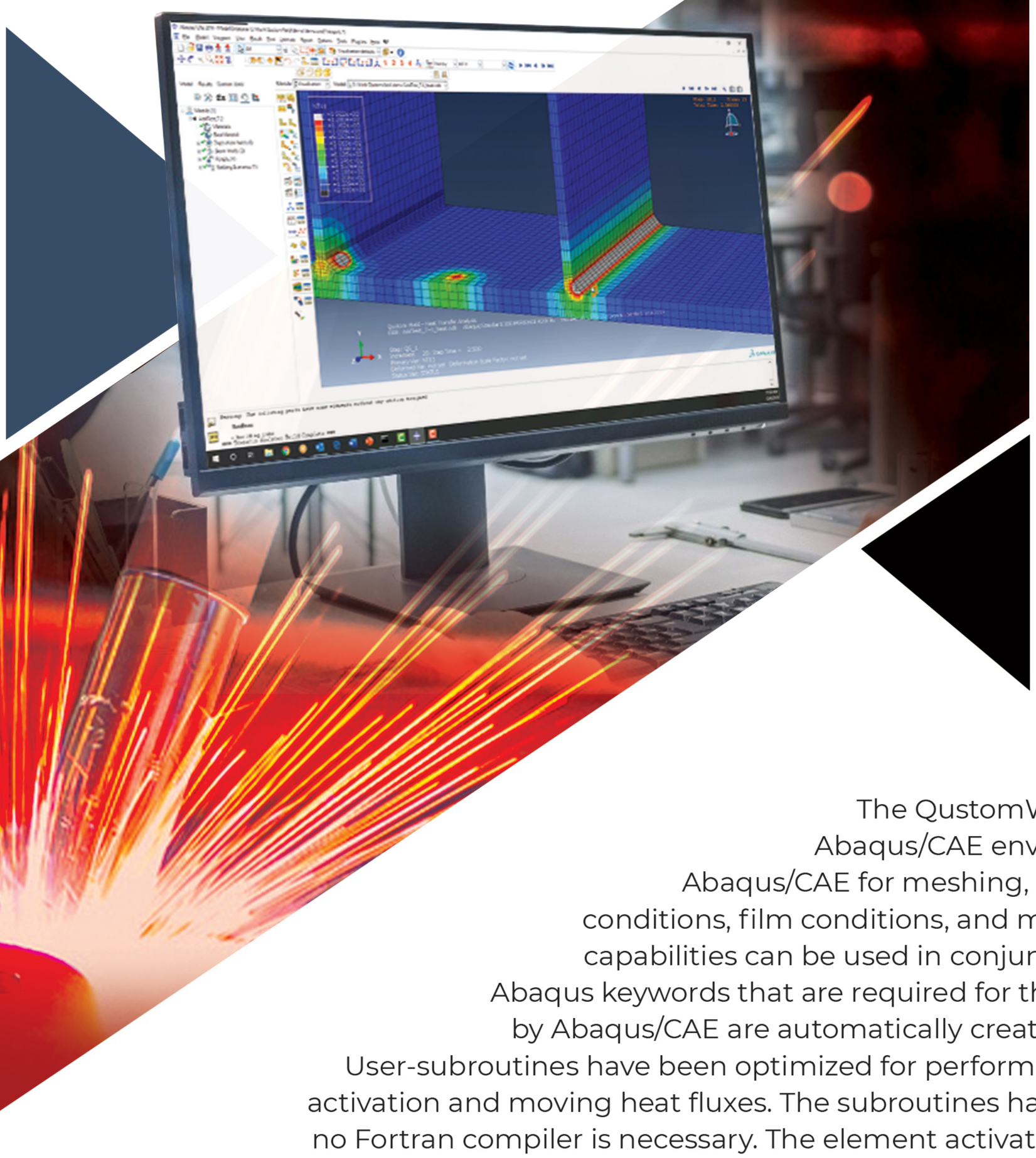
QUSTOMAPPS

# QustomWeld

## **Abaqus** Extension for *Welding Simulations*

This application brief describes the Abaqus extension QustomWeld which provides the capability of building 2D and 3D welding simulations within the Abaqus environment. The tool automates the task of building entire welding simulation models, from weld bead selection, torch path normal calculation and element insertion to welding scenarios and output histories. The QustomWeld interface is designed around simulating an environment in which multiple robots lay down deposition or beam (autogenous) welds onto a structure simultaneously. Complex robot sequencing can be simulated, whether welds are laid down simultaneously, sequentially, or a combination of the two. Any of these is possible for one or many robots.



The QustomWeld interface is built into the Abaqus/CAE environment. All the tools within Abaqus/CAE for meshing, applying loads and boundary conditions, film conditions, and most other native Abaqus/CAE capabilities can be used in conjunction with QustomWeld. Any Abaqus keywords that are required for the analysis but not supported by Abaqus/CAE are automatically created within the keyword editor. User-subroutines have been optimized for performance to simulate the element activation and moving heat fluxes. The subroutines have been built into a library, so no Fortran compiler is necessary. The element activation and torch subroutines are based on new Abaqus technology developed for simulating 3D printing.

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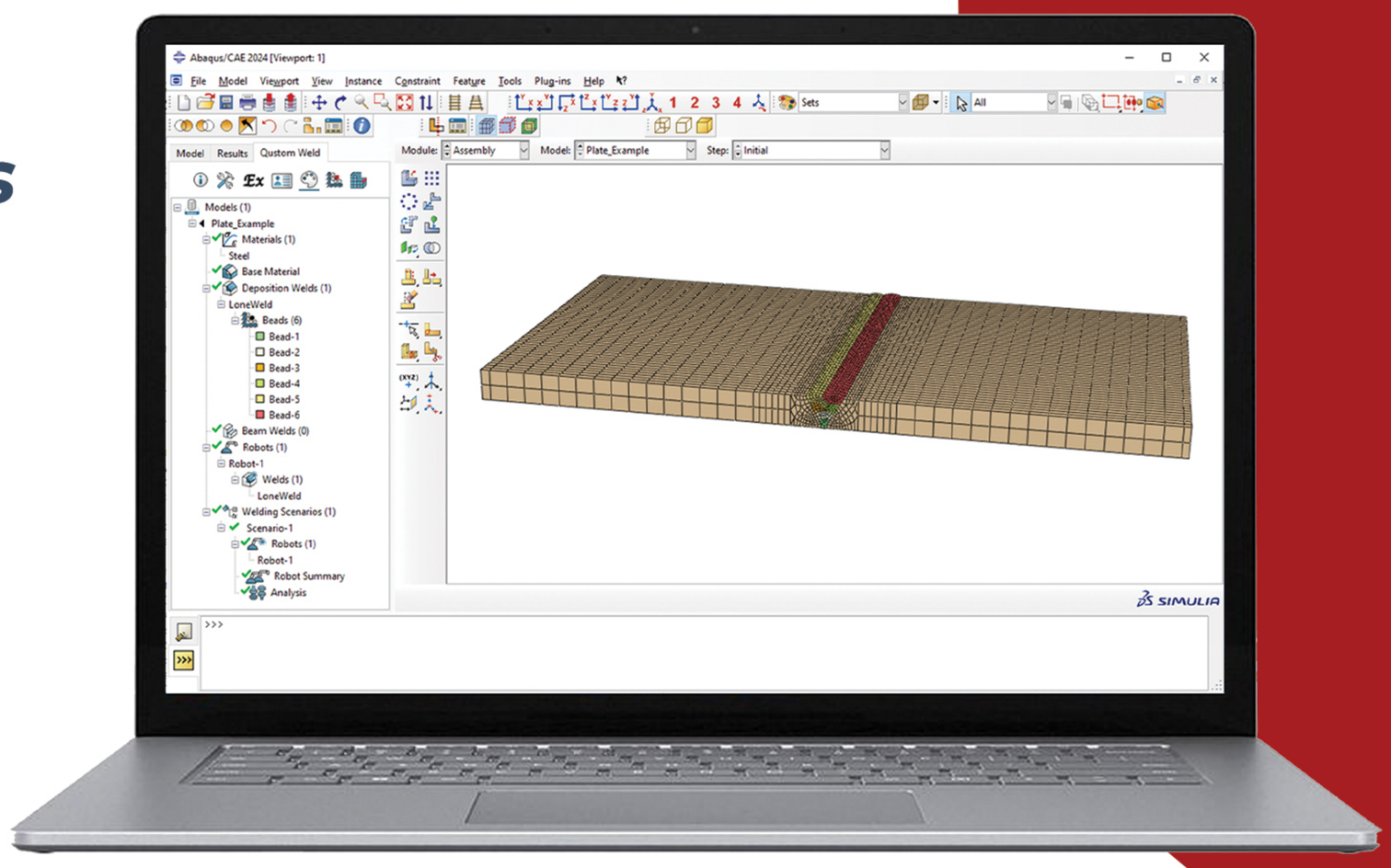



### Base Material Selection

- Selected by picking regions geometry or orphan meshes
- Model geometry can be imported from 3rd party software or built within Abaqus/CAE
- Phase Transformation materials are available through the 〖Dante〗^® library

### Deposition Welds

- Selected by geometry or orphan mesh
- Torch normals can be computed by centroid, adjacent element normals, coordinate system, or user-defined table
- Highlighting and color-coding assist in bead and torch path selection
- Energy-based torch controls
- Torch flux can be applied in either a Goldak double-ellipsoid flux or a constant flux
- Temperature-based chunking in 2D and 3D
- Partial element activation in 3D allows for fast simulation of large models (100-200 beads)

### Beam (Autogenous) Welds

- Beam or laser welds are welds in which material is not deposited; user is essentially defining a moving torch.
- Torch flux applied through either a layered-Pyo (double-ellipsoid in-plane, linear variation out of plane) or a layered-constant conical flux

### Robots

- Deposition and Beam robots define the default characteristics of their weld beads
- Welds are assigned to each robot

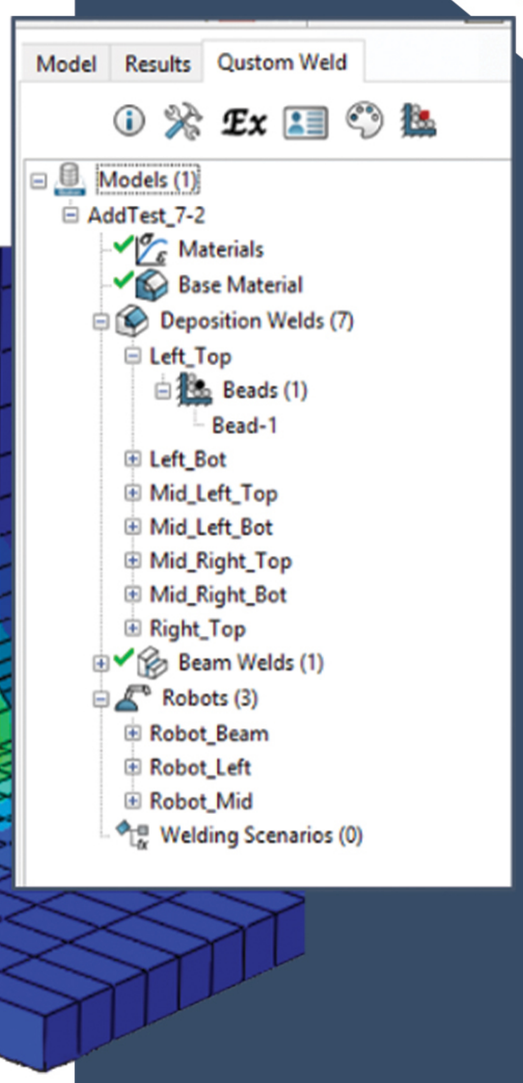
### Welding Scenarios

- A welding scenario is created automatically based on robot controls, but can be modified to control the following for each robot:
  - Weld and bead sequence
  - Cool down times between beads
  - Bead direction (forward or reverse)
  - Bead activation (on or off)
- Controls for sequential or simultaneous bead placement between the robots

### Analysis Controls

Analysis controls can be made to vary significantly in the level of controls that can be applied. These include:

- Deposition and Beam welds can be laid sequentially or in any number of chunks, including a single chunk
- Many time incrementation and output controls can be based on entire model, weld-by-weld, or bead-by-bead
- Bead termination by cool down temperature




### For More Information:


Please see our website at qustomapps.com, or contact Maria Shubert at

✉ maria.shubert@qustomapps.com