ABSTRACT
This work deals with an advanced model for spotwelds in finite element structures under mechanical loads, and is an enhancement of an existing linear elastic model (Heubrandtner, 2003). We develop a hybrid finite spotweld element based on Trefftz-method. It covers the spotweld nugget and small adjacent areas of the metal sheets with polygonal boundaries, the interface to the standard finite element mesh. A variational principle, valid within the framework of Hencky-plasticity with von Mises yield criterion, is the starting point to deduce all required Trefftz solutions. The modelling of perfectly plastic deformation accounts for geometrically nonlinear behaviour (stress stiffening) within the metal sheet annulus and permits the forming of plastic hinges along the circumference of the comparatively rigid nugget. Isotropic hardening is considered by means of a cascaded piecewise perfectly plastic stress-strain curve, leading to a high resolution of the stress/strain field in the vicinity of the spotweld nugget. Thus it enables the introduction of more accurate stress/strain-based failure criteria. Spotweld failure due to the onset of local necking (instability) in the vicinity of the nugget is investigated in more detail and shows a good agreement with experimental results. This spotweld element is implemented in ANSYS as User Element.