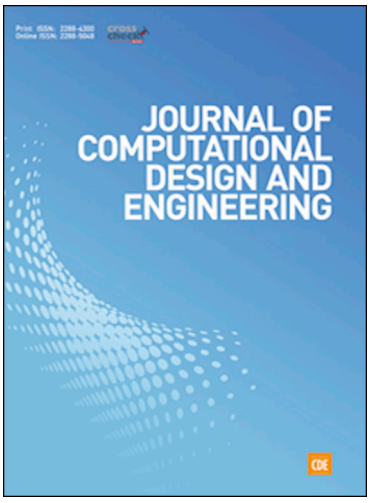

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Christian Zeller, Binu Surendran, Micheal F. Zaeh

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Parameterized Extended Finite Element Method for High Thermal Gradients

Christian Zeller[a,*], Binu Surendran[b], Micheal F. Zaeh[a]

[a] *TUM Department of Mechanical Engineering, Institute for Machine Tools and Industrial Management, Technical University of Munich, Germany*
[b] *Faculty of Mechanical and Process Engineering, University of Applied Sciences Augsburg, Germany*

Abstract

The Finite Element Method results in inaccuracies for temperature changes at the boundary if the mesh is too coarse in comparison with the applied time step. Oscillations occur as the adjacent elements balance the excessive energy of the boundary element.

An Extended Finite Element Method (XFEM) with extrinsic enrichment of the boundary element by a parameterized problem-specific ansatz function is presented. The method is able to represent high thermal gradients at the boundary with a coarse mesh as the enrichment function compensates for the excessive energy at the element affected by the temperature change. The parameterization covers the temporal change of the gradient and avoids the enrichment by further ansatz functions. The introduced parameterization variable is handed over to the system of equations as an additional degree of freedom. Analytical integration is used for the evaluation of the integrals in the weak formulation as the ansatz function depends non-linearly on the parameterization variable.

Keywords: XFEM, heat equation, steep thermal gradients, thermal shocks, parameterized ansatz functions

*Corresponding author
Email address: christian.zeller@iwb.mw.tum.de (Christian Zeller)