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Contact modeling within displacement-based refined one-dimensional beam models

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The paper presents a novel contact formulation for higher-order beam elements developed within the scheme of the Carrera Unified Formulation (CUF) [1]. One-dimensional CUF models assume variable kinematic descriptions over the cross-section of the beam without any ad-hoc assumptions. CUF makes use of fundamental nuclei to express the governing equations independently of the order of the structural theory. In this work, Lagrange-type polynomials are used to interpolate the displacement field over the cross-section leading to a purely displacement-based refined one-dimensional model. An efficient global contact algorithm scheme utilizes the accurate displacement field to precisely enforce the contact constraints. The contact fundamental nucleus is formulated through the consistent linearization of contact contribution, thus allowing their application within implicit time integration scheme. Typical limitations associated with beam-to-beam contact formulations [2] are easily eradicated through the unified formulation. The proposed work extends the advanced capabilities of CUF framework to approximate accurate 3D fields at a reduced computational overhead for solving contact problems. A numerical simulation campaign, including patch tests and benchmark tests, is undertaken to verify the accuracy and efficiency of the proposed contact modeling within the CUF framework.

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