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DIRECTOR-BASED IGA BEAM ELEMENTS FOR SLIDING CONTACT PROBLEMS

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In many engineering problems, beams play an important role. The geometrically exact beam theory gives rise to an important class of beam elements in the non-linear regime. For instance it can be used to simulate aerial runways or pantograph-catenaries, where a sliding contact between two or more beam elements is used to resemble the real-world problem. To bypass any kinks, which are not represented in the real-world geometry, a smooth discretization of at least C^1 continuity is needed. This can be achieved using the isogeometric analysis (IGA) proposed by Hughes and coworkers [1]. So in the fist step we apply the IGA to the director-based formulation of the geometrically exact beam [2]. In particular, we aim at a frame-indifferent discrete model of the beam which inherits the conservation laws of the underlying continuous beam theory.
Time integration schemes tend to be far more stable if they conserve properties from the continuous system exactly. Thus, we apply an energy-momentum conserving scheme to the director-based geometrically exact IGA beam formulation. Using the notion of a discrete gradient introduced by Gonzalez [3], an energy-momentum conserving algorithm can be constructed, including the case of sliding contact. This, however, leads to an increase of the unknowns as augmented coordinates and associated constraints need to be introduced. To reduce the system to the minimal set of unknowns we apply the discrete null space method to the problem [4].

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