Geometrical covariant approach for contact between curves representing beam and cable type structures.

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Recent developments [1], [2] in numerical contact mechanics especially in the case of large deformations have shown the robustness of the covariant approach. Following the geometrical interpretation of this approach, the contact interaction between bodies is considered as an interaction between surfaces and is carried out in a specially defined local surface coordinate surface related to the surface. This coordinate system is defined after the closest point projection (CPP) procedure in which a chosen "slave" point from one contacting body is projected to the "master" surface of another contacting body. For numerical algorithms all necessary parameters are related then to the surface coordinate system and are written in a covariant form. It leads to a description which is independent of discretization of the contact surfaces e.g. by FE and can be applied even for high-order FE with exact representation of the geometry [3].

The geometrical approach for curve-to-curve interaction appears to be more complicated because both contacting points should be found via the CPP procedure [4]. Only a few publications are known mostly for cases with linear geometry; e.g. a case with curvilinear beams is considered in [5] in which all necessary derivatives have been computed via the symbolic algebra program.

The full covariant approach developed in the current contribution includes then the observation of the contact in Serret-Frenet coordinate system attached to the curves. This allows to study solvability conditions (existence, uniqueness) of the related CPP procedure and consider independently a relative motion of the selected curve. All necessary contact terms as well as the following linearization are considered in the local coordinate system. It leads to a formulation which is independent of the approximation of both curves. This description is then applicable for contact between curved beams and cables as well as for contact between surface edges.

References

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