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G^1-conforming Bézier FE formulation for the analysis of Kirchhoff rod assemblies

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A symmetric G^1-conforming formulation suitable for the non linear analysis of assembly of slender curved beams is presented. The symmetric tangent stiffness operator is formally derived performing the second covariant derivative of the internal energy functional, for which the Levi-Civita connection of the configurations manifold of the considered beam model is needed.

The G^1-continuity conditions are fulfilled by means of a change of basis, from the original configuration parameters a to new set of configuration parameters is introduced. On this way, as shown in [1, 2] a new non-linear map is introduced for which an additional geometric term in the tangent stiffness matrix is accounted.

The robustness and accuracy of the obtained Kirchhoff model is demonstrated with numerical examples that employ Bézier interpolation for the position and for the rotation angle.

Furthermore, this beam formulation can be coupled with the G^1-conforming shell formulation proposed in [3].

REFERENCES

[1] Greco L., An iso-parametric G^1-conforming finite element for the nonlinear analysis of Kirchhoff rod. Part I: the 2D case, *Continuum Mechanics and Thermodynamics*, Vol. **32**(5), pp. 1473 - 1496, 2020.

[2] Greco L., Scrofani A., Cuomo M. A non-linear symmetric G^1-conforming Bézier finite element formulation for the analysis of Kirchhoff beam assemblies. *Computer Methods in Applied Mechanics and Engineering*, Vol. **387**, n. 114176, 2021.

[3] Greco L., Cuomo M., An implicit G^1-conforming bi-cubic interpolation for the analysis of smooth and folded Kirchhoff-Love shell assemblies. *Computer Methods in Applied Mechanics and Engineering*, Vol. **373**, n. 113476, 2021.