A new implicit G^1-conforming bi-cubic quadrilateral element for the analysis of Kirchhoff-Love shell

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ABSTRACT

Bi-cubic quadrilateral G^1-conforming finite element for the analysis of Kirchhoff-Love shell is presented. The conformity requirement are implicitly accounted at the local element formulation. This element is designed on the base of the boundary ribbon interpolation, analogously to [1].
The ribbon is a differential manifold conceived to mimic the kinematic of the boundary of a Kirchhoff-Love shell. Ribbons are defined by means of the boundary curve and the boundary parametric tangents attached to it. Fundamentally, the ribbons are tangent ruled surfaces at the boundary edges of the generic surface patch. Assigned the ribbon configurations, the control points for the rational Gregory Patch approximant (see [2]), are uniquely defined. By controlling the ribbons implicit G^1-conforming finite element can be designed.
In order to pass the patch tests (in-plane and bending patch-test) and obtaining the optimal rates of convergence (under h-refinement) the rational approximant is enforced to be polynomial. Finally, the constrained CG^1-formulation presented in [3, 4, 5] is adapted for the case of the Kirchhoff-Love shell model.
Finally, general G^1-conforming finite elements can be designed for the analysis of shell structures.

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