LR B-Splines implementation in the Altair Radioss solver for explicit dynamics IsoGeometric Analysis

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ABSTRACT

Isogeometric analysis has shown to be a very promising tool for an integrated design and analysis process [1]. A challenging task is still to move IGA from a proof of concept to a convenient design tool for industry and this work contributes to this endeavor. This communication deals with the implementation of IGA into Altair's Radioss explicit solver in order to address crash and stamping applications. To this end, the necessary ingredients to a smooth integration of IGA in a traditional finite element code have been identified and adapted to the existing code architecture. First, a solid NURBS element has been developed in Radioss and then, an existing contact interface has been extended in order to work seamlessly with both NURBS and Lagrange finite elements, using a node to surface formulation. Some academic and simple industrial cases will be presented to show the obtained results and the relevance of the retained solution. Mesh refinement is the third ingredient added to this integration, as local refinement is needed for solution approximation and computational efficiency. Several existing splines technologies with local refinement were compared in terms of implementation and data management requirements, amongst which Hierarchical B-Splines [2], Truncated Hierarchical B-Splines [3] and Locally Refined B-Splines [4], the latter being implemented into Radioss. The approach is tested on industrial benchmarks such as metal stamping and drop tests, generally used for assessing commercial code performance.

REFERENCES

[1] J.A. Cottrell, T.J.R. Hughes and Y. Bazilevs, Isogeometric Analysis: towards integration of CAD and FEA, Wiley, (2009).

[2] A.V. Vuong, C. Giannelli, B. Jüttler and B. Simeon, A hierarchical approach to adaptive local refinement in isogeometric analysis, Computer Methods in Applied Mechanics and Engineering, Vol. 200, pp. 3554-3567 (2011).

[3] C. Giannelli, B. Jüttler and H. Speelers, THB-splines: the truncated basis for hierarchical splines, Computer Aided Geometric Design, Vol. 29, pp. 485-498 (2012).

[4] K.A. Johannessen, T. Kvamsdal and T. Dokken, Isogeometric analysis using LR B-splines, Computer Methods in Applied Mechanics and Engineering, Vol. 269, pp. 471-514 (2014).