The simplest fully nonlinear triangular shell element

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Shells are one of the most important models in solid mechanics since many structures in engineering may be associated with it: metal sheets-based products, slabs, thin-walled pressure vessels, and other objects with one of its dimensions considerably smaller than others. Shell models may be adaptable to finite element usage, but some particularities must be watched it, such as locking behaviours.

This work aims to study and develop a nonlinear formulation for shells models using a special simple triangular shell element named here T3-3i, which is a new displacement-based triangular shell element with 6 nodes. Moreover, the shear locking and membrane locking behaviour are not observed at the performance of this new element.

In formulation of shell models, we consider finite strains, large displacements, and rotations. Rotation field is re-parameterized in terms of the Rodrigues rotation vector, resulting in a simpler update of rotational variables. The Reissner-Mindlin kinematical assumption and an initial plane reference configuration for the shell is considered here.

A computational implementation is done with several numerical examples using the new element T3-3i. Furthermore, a comparison with numerical examples using the well-known element T6-3i [1], a six parameter (3 displacements and 3 rotations) element, is done with the aim to also illustrate the robustness of our formulation.

REFERENCES

[1] E. M. B. Campello, P. M. Pimenta and P. Wriggers, A triangular finite shell element based on a fully nonlinear shell formulation. *Comput Mechanics.*, Vol. **31**, pp. 505-518, 2003.
[2] E. M. B. Campello, P. M. Pimenta and P. Wriggers, An exact conserving for nonlinear dynamics with rotational DOFs and general hyperelasticity – Part 1: rods *Comput Mechanics.*, Vol. **42**, pp. 715-732, 2008.
[3] E. M. B. Campello, P. M. Pimenta and P. Wriggers, An exact conserving for nonlinear dynamics with rotational DOFs and general hyperelasticity – Part 2: shells *Comput Mechanics.*, Vol. **48**, pp. 195-211, 2011.
[4] O.C. Zienkiewicz and R.C. Taylor, *The finite element method*, 6th Edition, Elsevier, 2005.
[5] J. Korelc and P. Wriggers, Automation of Finite Element Methods. Springer International Publishing, Switzerland, 2016