Co-rotational thin membrane elements

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Abstract

The co-rotational (CR) technique is a kinematics description, which can be traced back to work by Wempner\(^1\). Up to now, most of the research efforts on a co-rotational framework have been focused on beams and shells, but there are also some investigations extending the CR procedures to other continuum elements. A recent review of the state of the art of CR formulation is given by Felippa and Hauge\(^2\).

The concept of an element-independent co-rotational (EICR) formulation has been proposed by Rankin and coworkers\(^3\), with its most significant feature that extraction and integration of rigid body motion can be done in a module called CR filter, independent of linear element calculation.

A unified approach to the finite element method in a co-rotational (CR) framework is proposed. A commonly applicable filter was developed according to the framework, with which many nonlinear CR elements can be easily developed by integrating the filter with corresponding linear elements. The main points of the developed procedure is a generality in basic formulation, and an algorithm based on nodal contributions. The CR filter is formulated as a strict minimization problem, which is solved by rapidly converging Newton iterations.

Three continuum elements were developed in this framework\(^4\). Numerical examples with large displacements were tested with the CR elements developed in this way. The test results and the performance of the elements are analyzed, and conclusions are drawn, proving the unified approach to be promising, but also indicating the main problems with the CR framework.

References


