SAND2018-3268C

ELEMENT TECHNOLOGY

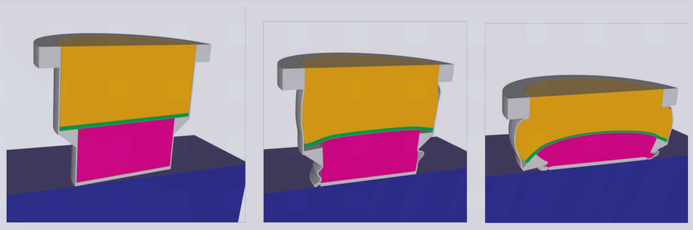
Sierra Solid Mechanics Development Team (PO: Jesse Thomas)

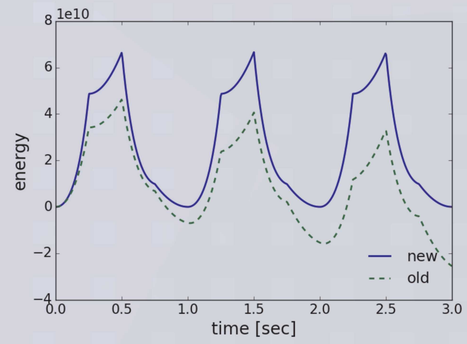
TOTAL-LAGRANGE UNIFORM GRADIENT HEX8 WITH HYPERELASTIC HOURGLASS

Recent Development

New total-lagrange + hyperelastic hourglass hex element formulation developed to better run large deformation problems

- Conserves energy
- Reversible
- Symmetric stiffness
- More stable

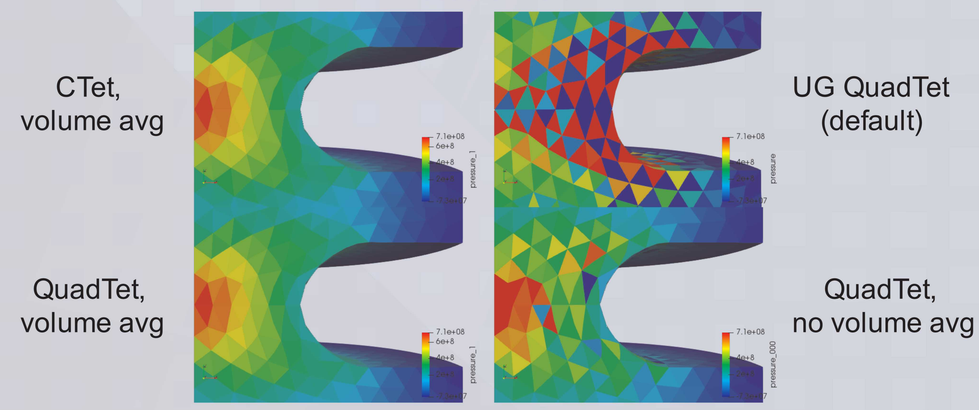




TOTAL-LAGRANGE COMPOSITE TET10

Motivation

- Trahedral meshing can be vastly easier than hex meshing
- Total-Lagrange composite tetrahedron is our best option for Sierra/SM



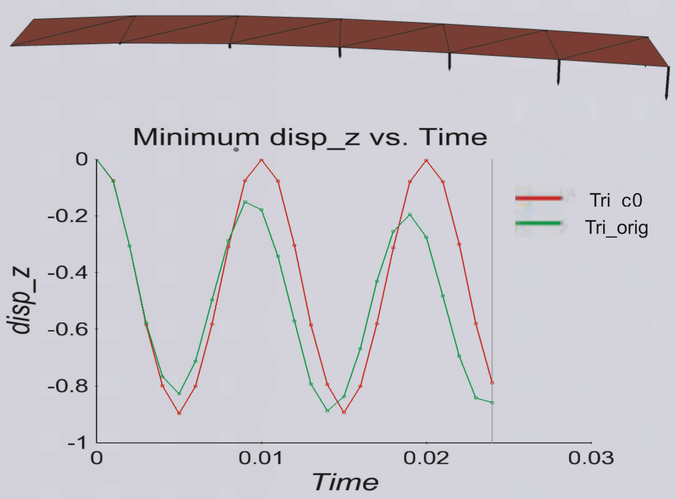
IMPLEMENT C0 TRIANGLE SHELL ELEMENT

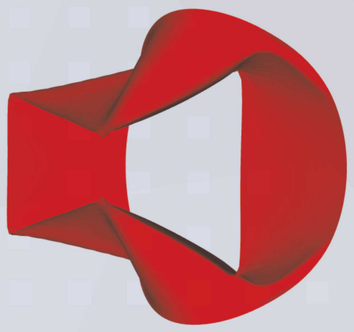
Background:

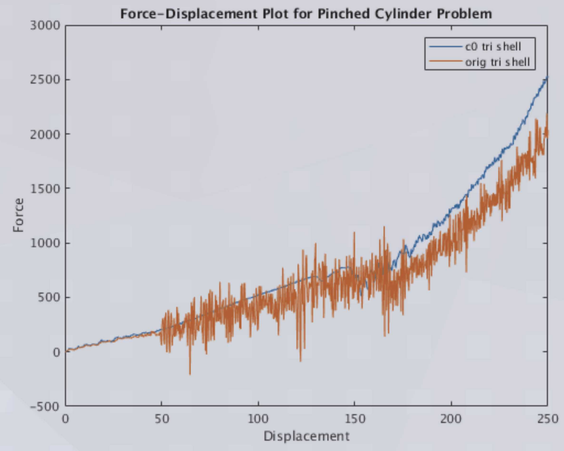
- A shell-element study for tri-shell elements was performed
- From this study, it was determined that the C0 tri shell element should be implemented

Done:

- Implemented the C0 tri shell (Belytschko, Lin, and Kennedy)
- Added a number of shell verification tests



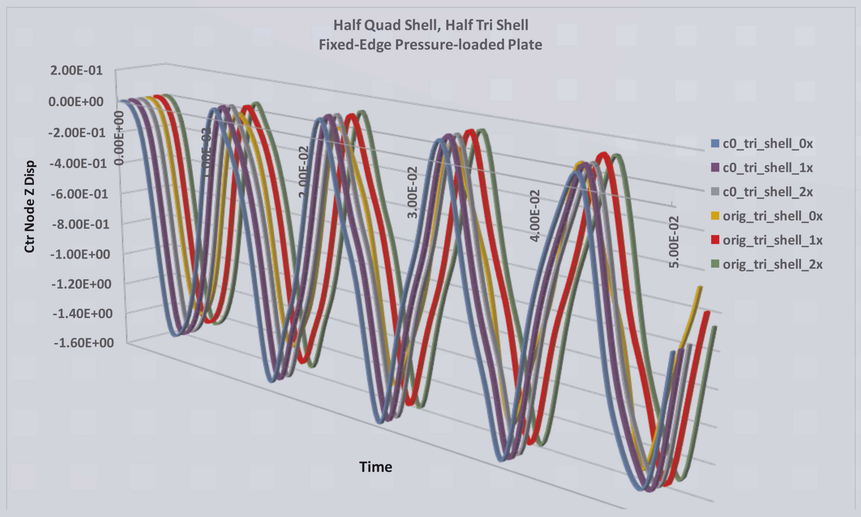




C0 TRI SHELL VS OLD TRI SHELL REFINEMENT STUDY

Combo mesh test problem

- 0x (original mesh), 1x, and 2x
- Each refinement halves element lengths



IMPLEMENT BELYTSCHKO-LEVIATHAN SHELL ELEMENT

Motivation:

- We wanted a better shell element in Sierra/SM than what was currently there
- A large shell element study concluded that the B-L shell was a good choice

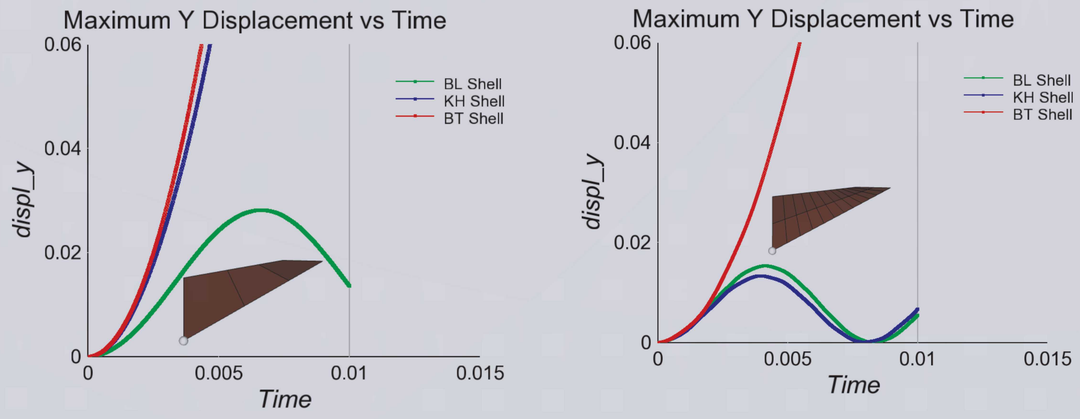
What Was Done:

- Implemented the B-L shell element, including the angular velocity and internal moment projections proposed in a later paper
- Results are very close to those in the literature and are better than the B-T and K-H shell for certain problems

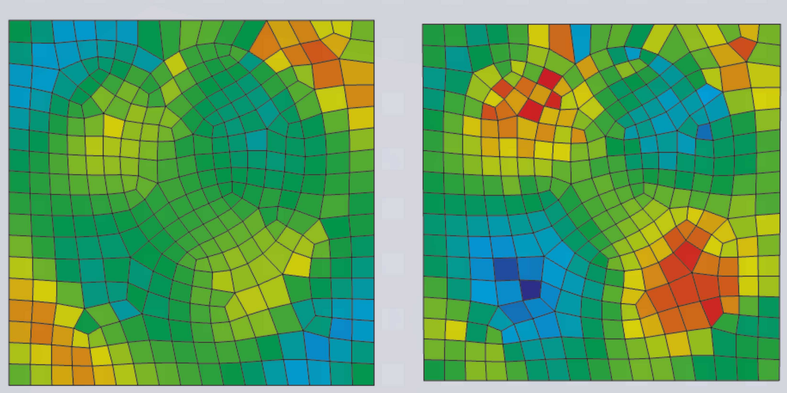
Unique Features:

- No hourglass control or drilling stiffness is needed for this element

Twisted Beam with no hourglass control or drilling



Pressure Loaded Plate – Transverse Shear Stress



BL Shell *KH Shell*

Twisted Beam Performance Comparison

384 elements	Time
Belytschko-Tsay	30.163s
Key-Hoff	38.568s
Belytschko-Leviathan	51.440s

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