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CRASH BOX MODEL

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INTRODUCTION

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Introduction

Objective:

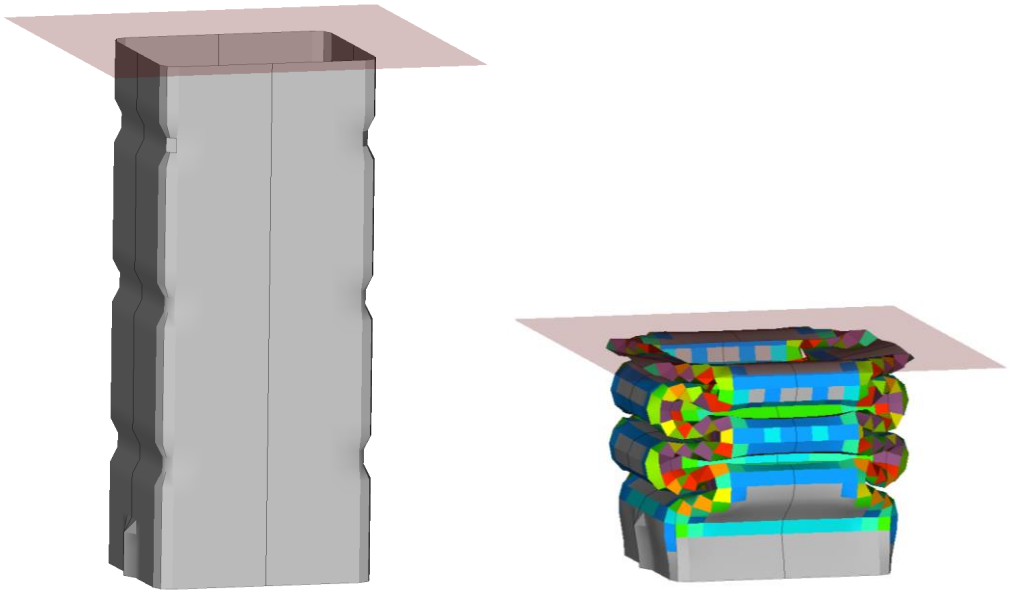
- The goal of this study is to showcase OptiStruct capabilities in structural explicit analysis.
- Different integration schemes are evaluated.
- A sensitivity study (wrt number of cores) is conducted.
- Comparisons are conducted between Radioss & OS explicit

Solutions used:

- Altair OptiStruct 2024

Unit System:

- Unit system: kg, mm, ms, GPa



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MODEL SETUP

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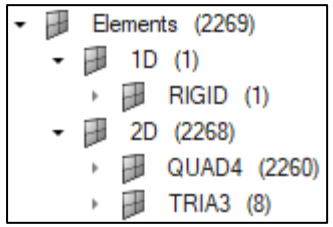
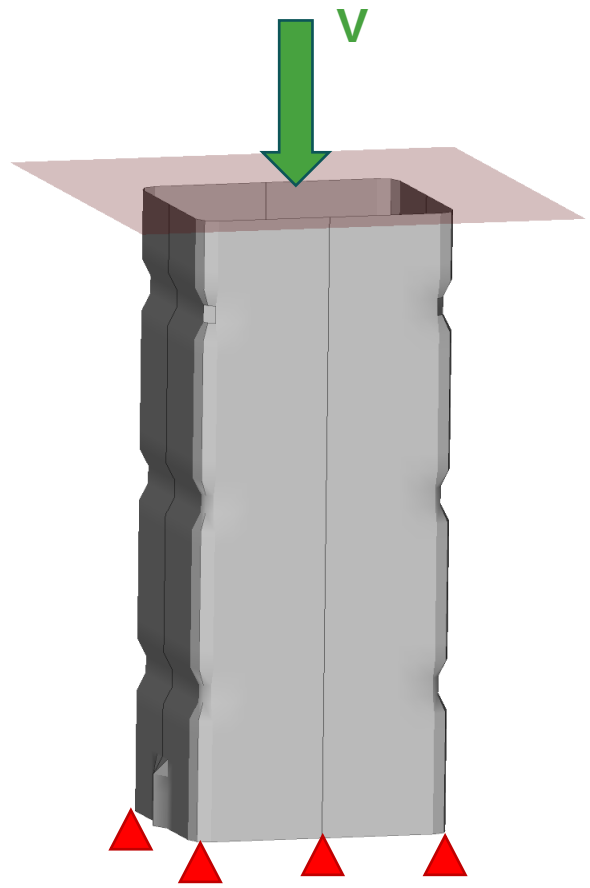
Model Setup

Global Overview

- This model represents a Crash Box. It is blocked on the bottom. On the top, a rigid wall with a mass of 800kg and a vertical velocity of 8.94mm/ms will crush the crashbox.
- The model is discretized with:



- The following slides will describe the OptiStruct setup.



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Model Setup

Material Law

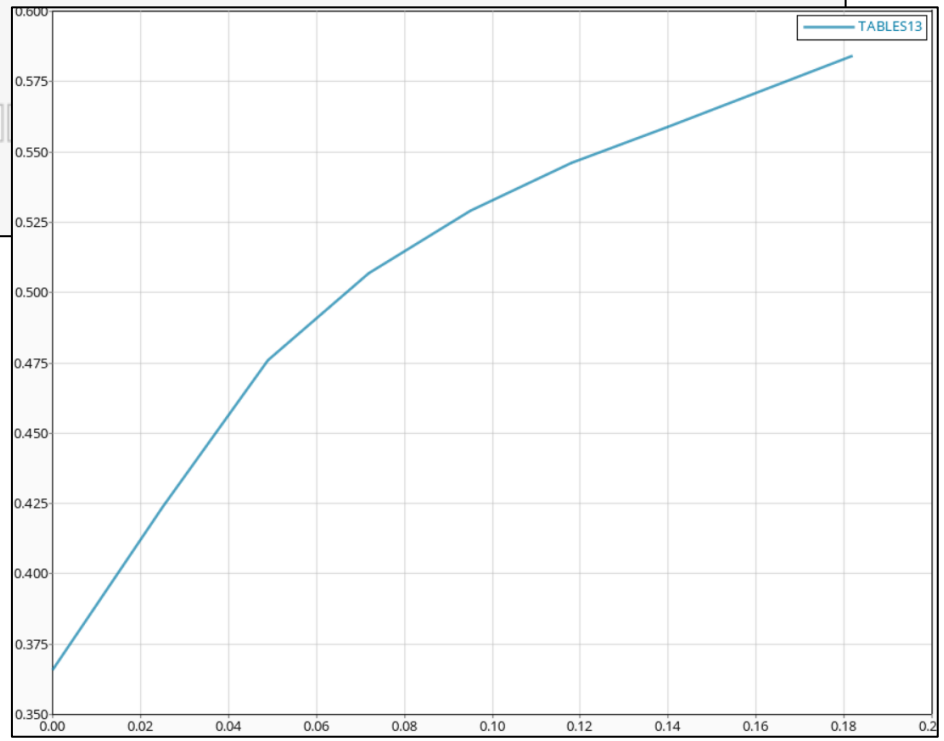
- The crashbox components are constituted of steel. A Von-Mises based tabulated plasticity model (MAT1 + MATS1, PLASTIC type) is used to represent the steel:

	ID	E	G	NU	RHO	A	TREF	GE
MAT1	1	200.0		0.3	7.83e-06			

	ST	SC	SS

	MID	TID	TYPE	H
MATS1	1	(3) TABLES13	PLASTIC	

	TYPSTRN
	1



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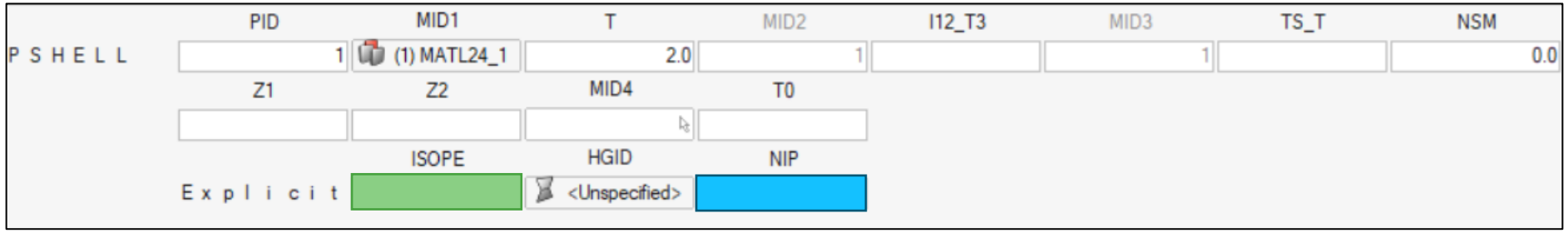
Model Setup

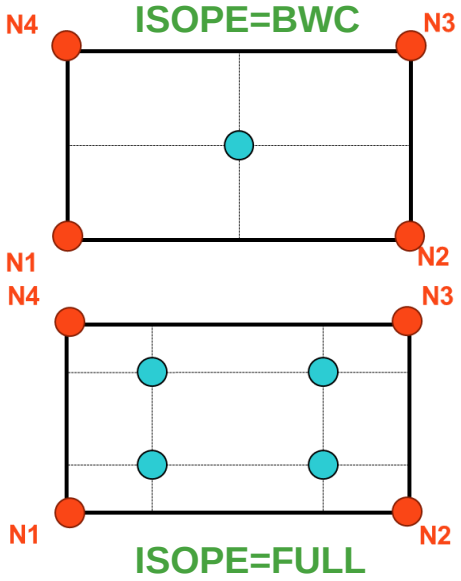
Properties

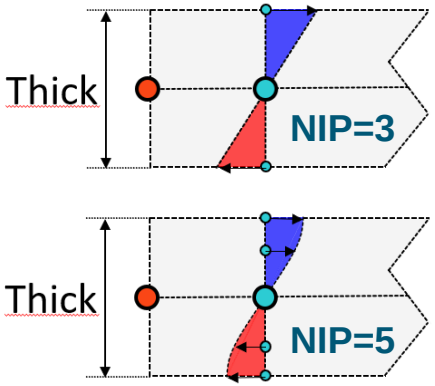
- Shell elements are used to mesh the crashbox plates.
- A PSHELL property card is used to specify the plate thickness (2mm), element formulation, & number of integration points through the thickness:



- Test Matrix:

ISOPE	NIP
FULL	3
FULL	5
BWC	3
BWC	5





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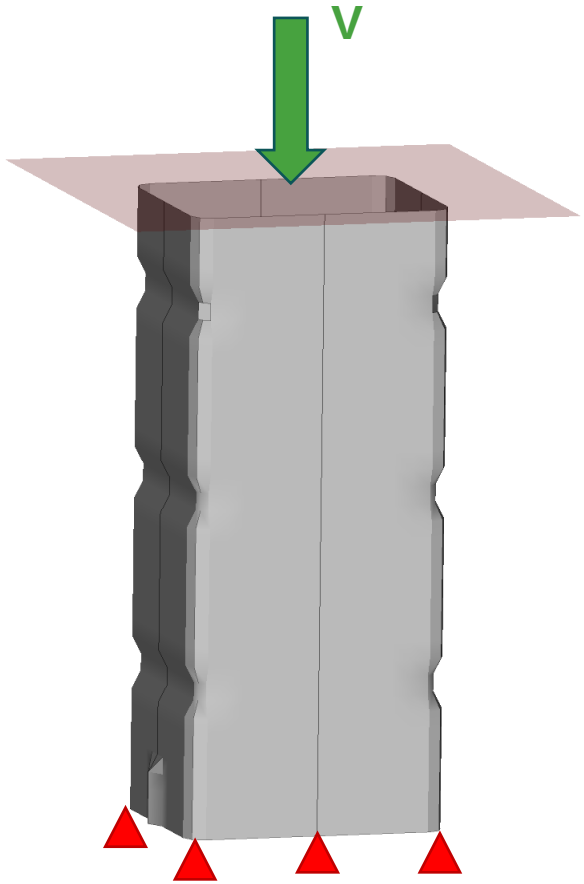
Model Setup

Loads

- The bottom of the crashbox is blocked in all directions using SPCs.
- A plate is meshed and put in a rigid body.
- An initial vertical velocity is applied to the main node of the rigid body using TIC:

	SID	G		V0
T I C	(2) vel	(100000) No...	3	-8.94

- The mass of the impactor is set to 800kg.



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SIMULATION RESULTS

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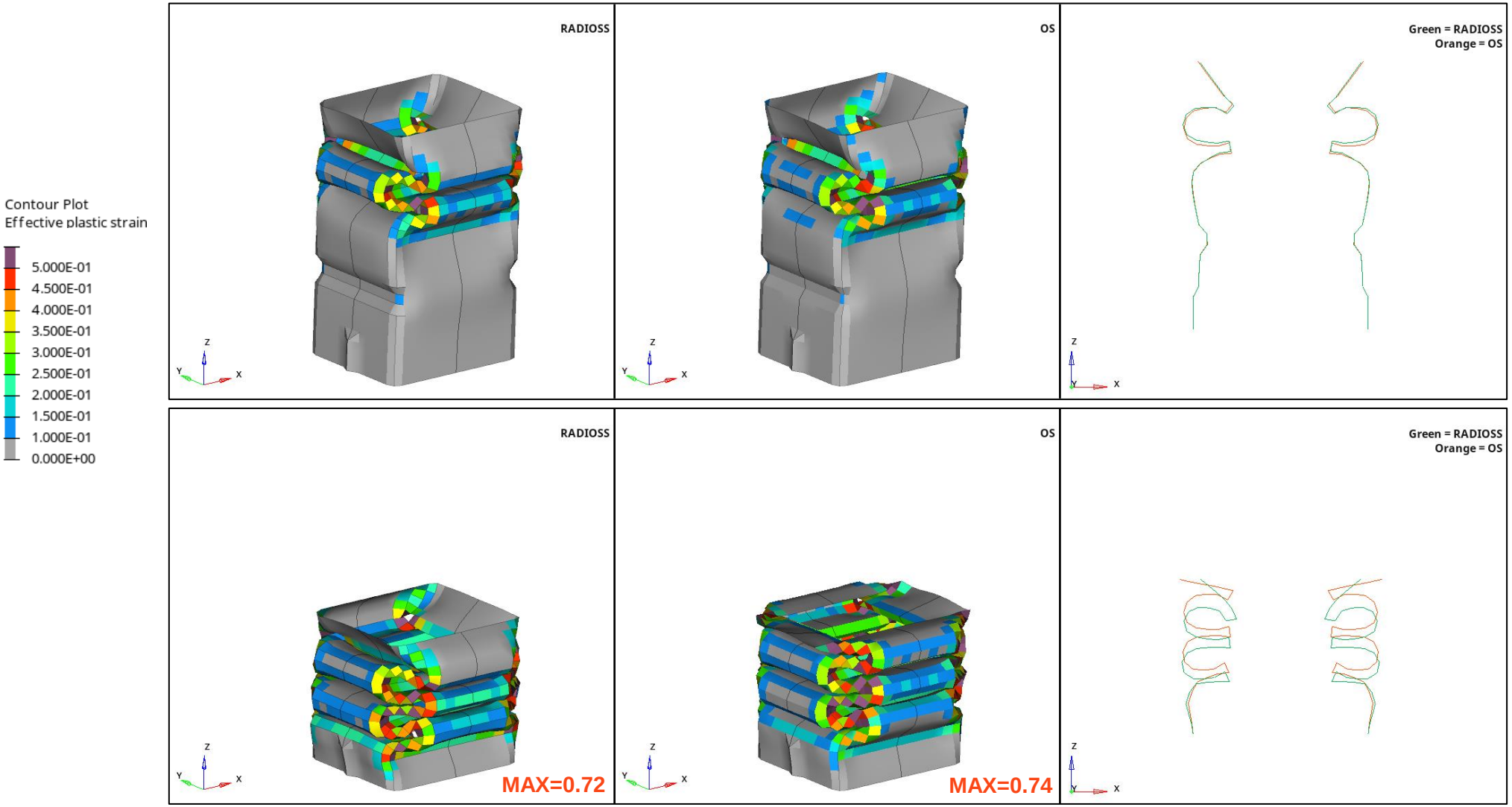
Simulation Results

Full Integration 3pts



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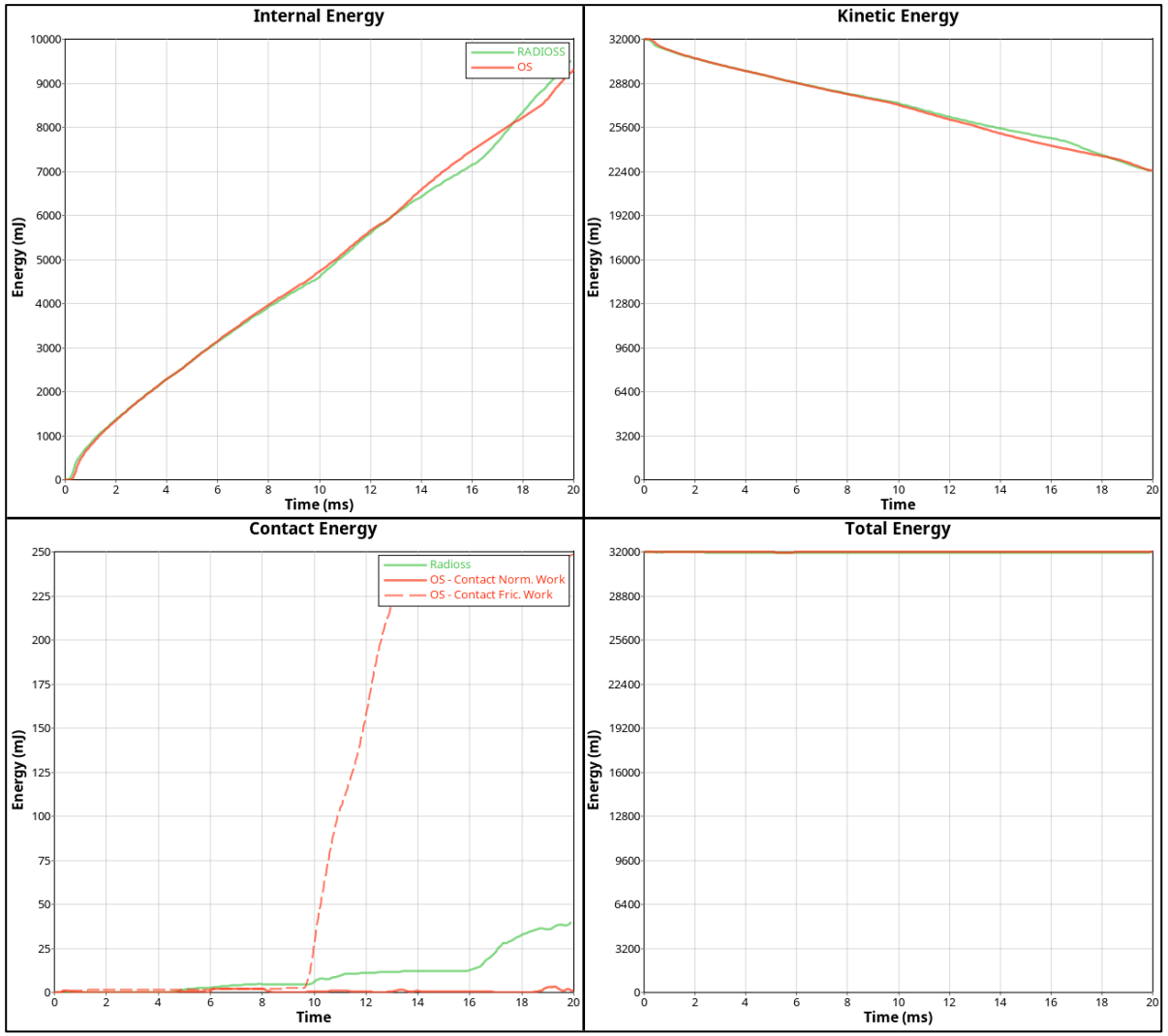
Simulation Results

Full Integration 3pts



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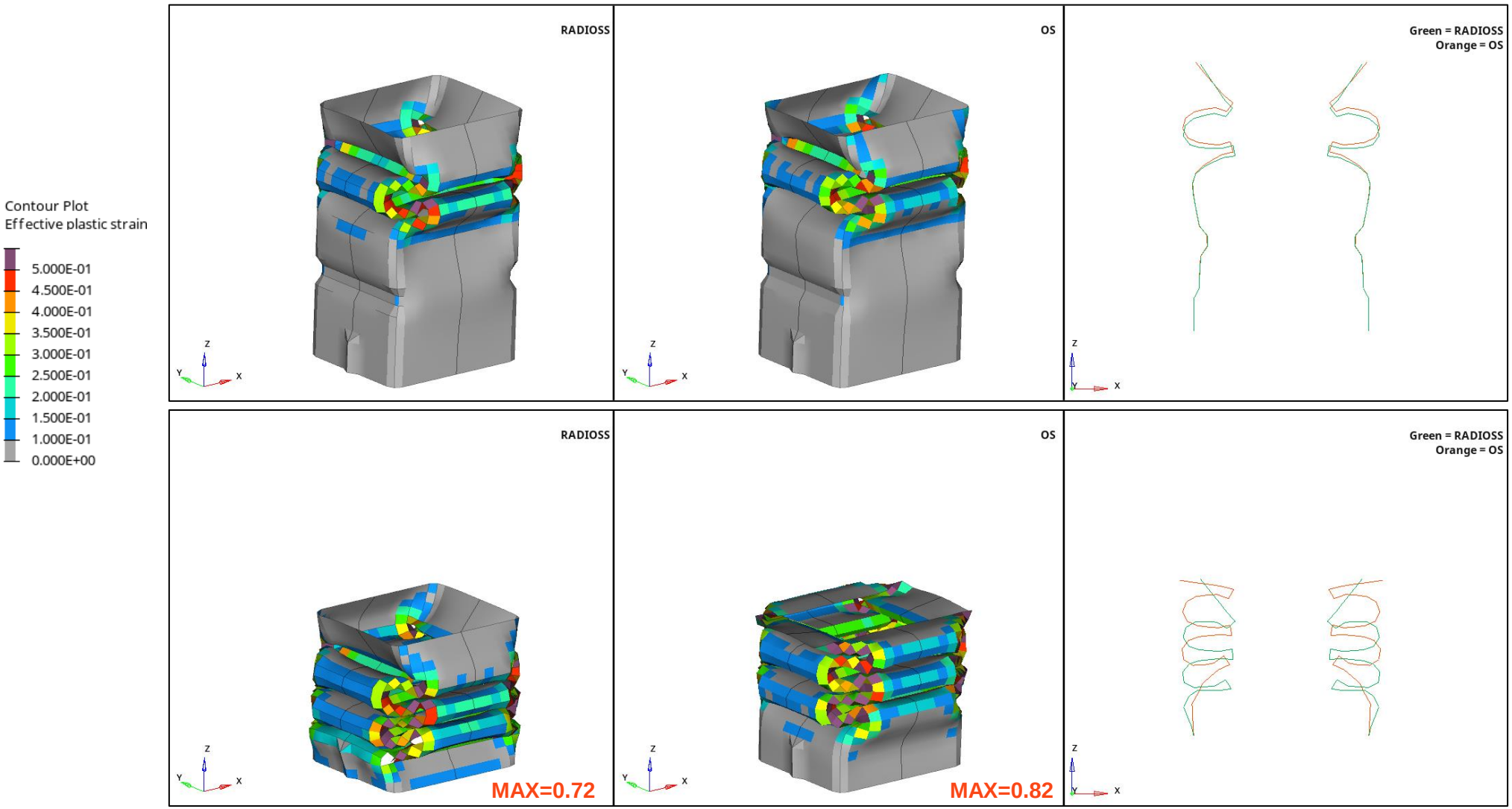
Simulation Results

Full Integration 5pts



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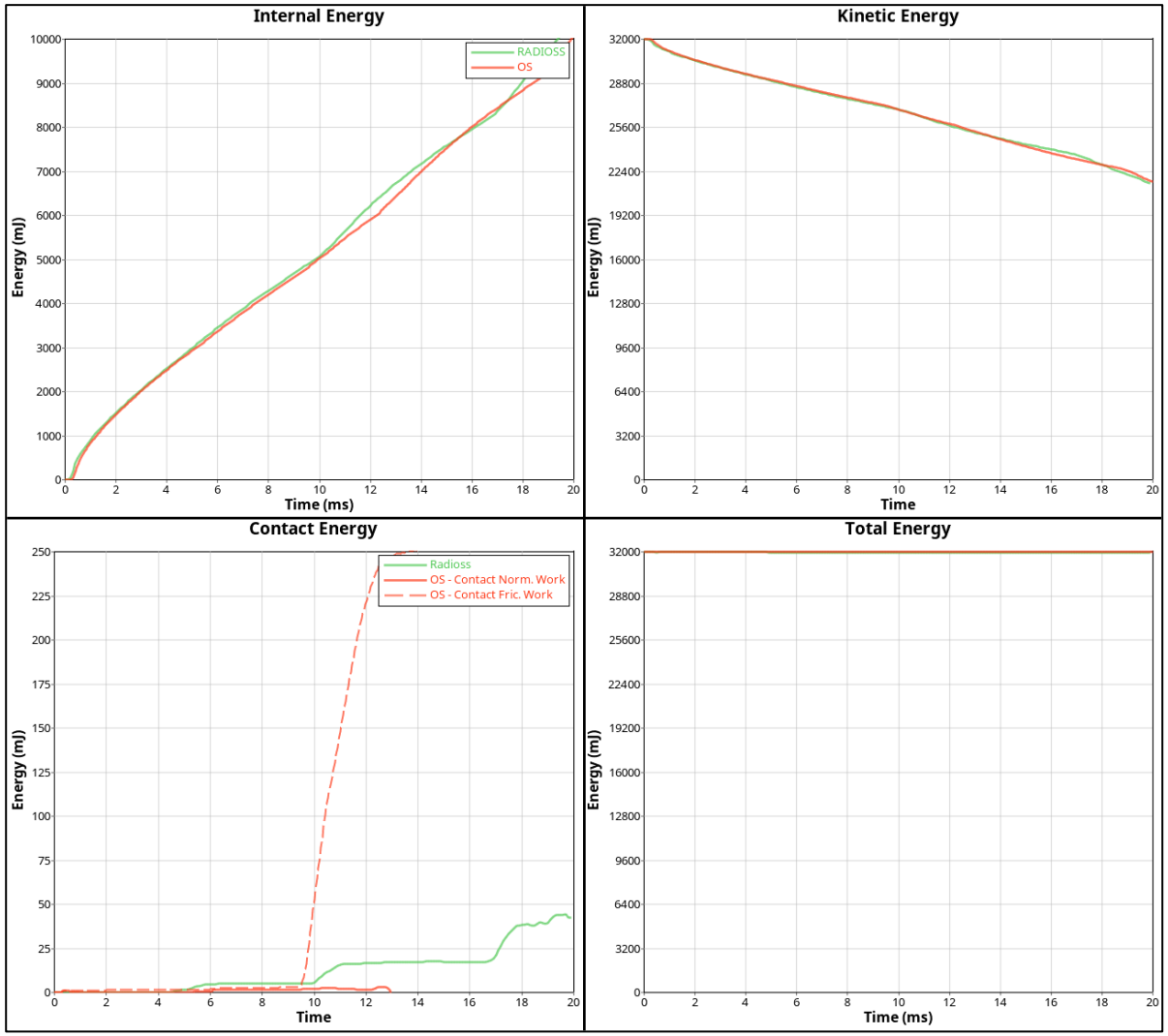
Simulation Results

Full Integration 5pts



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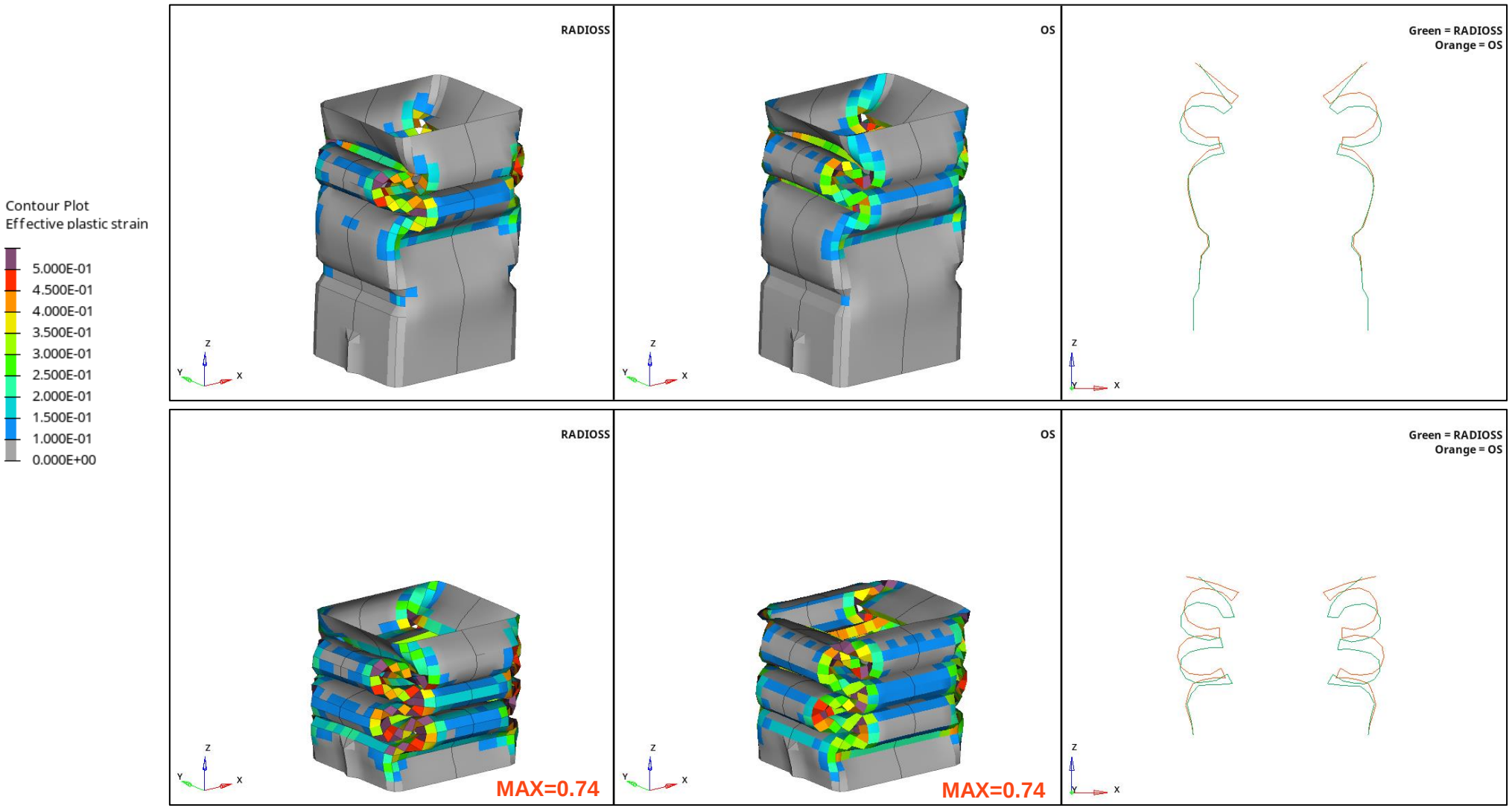
Simulation Results

Reduced Integration 3pts



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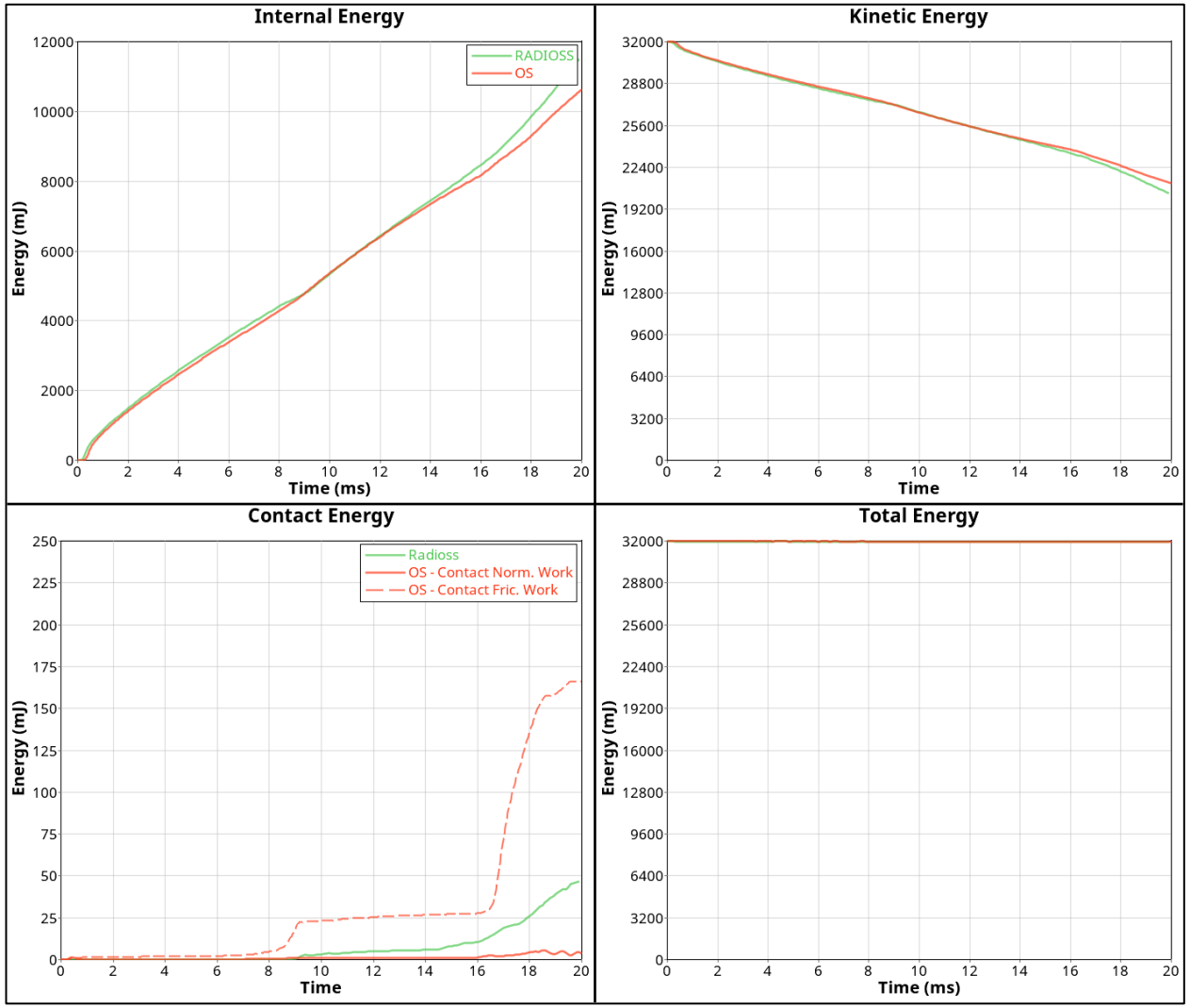
Simulation Results

Reduced Integration 3pts



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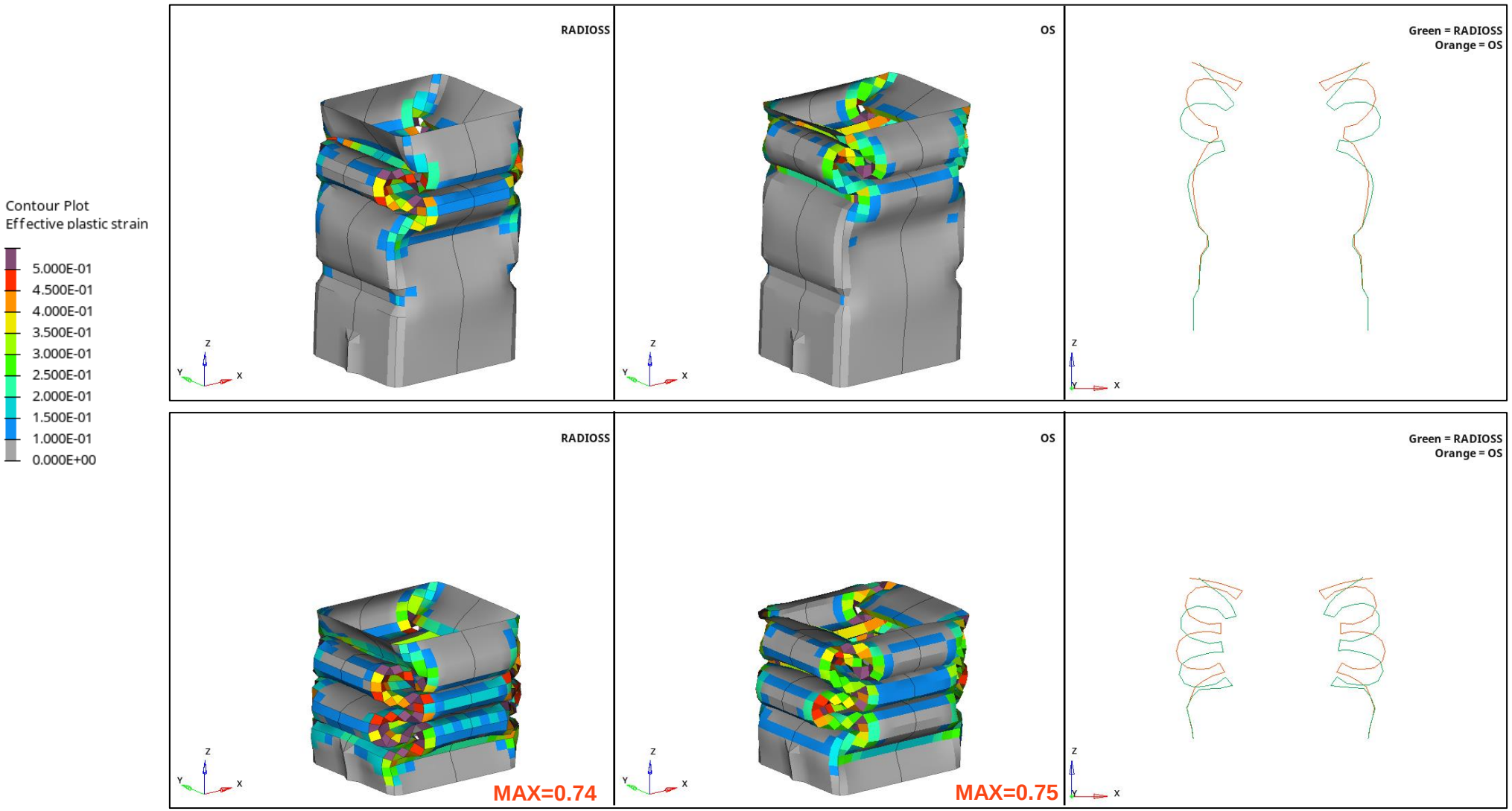
Simulation Results

Reduced Integration 5pts



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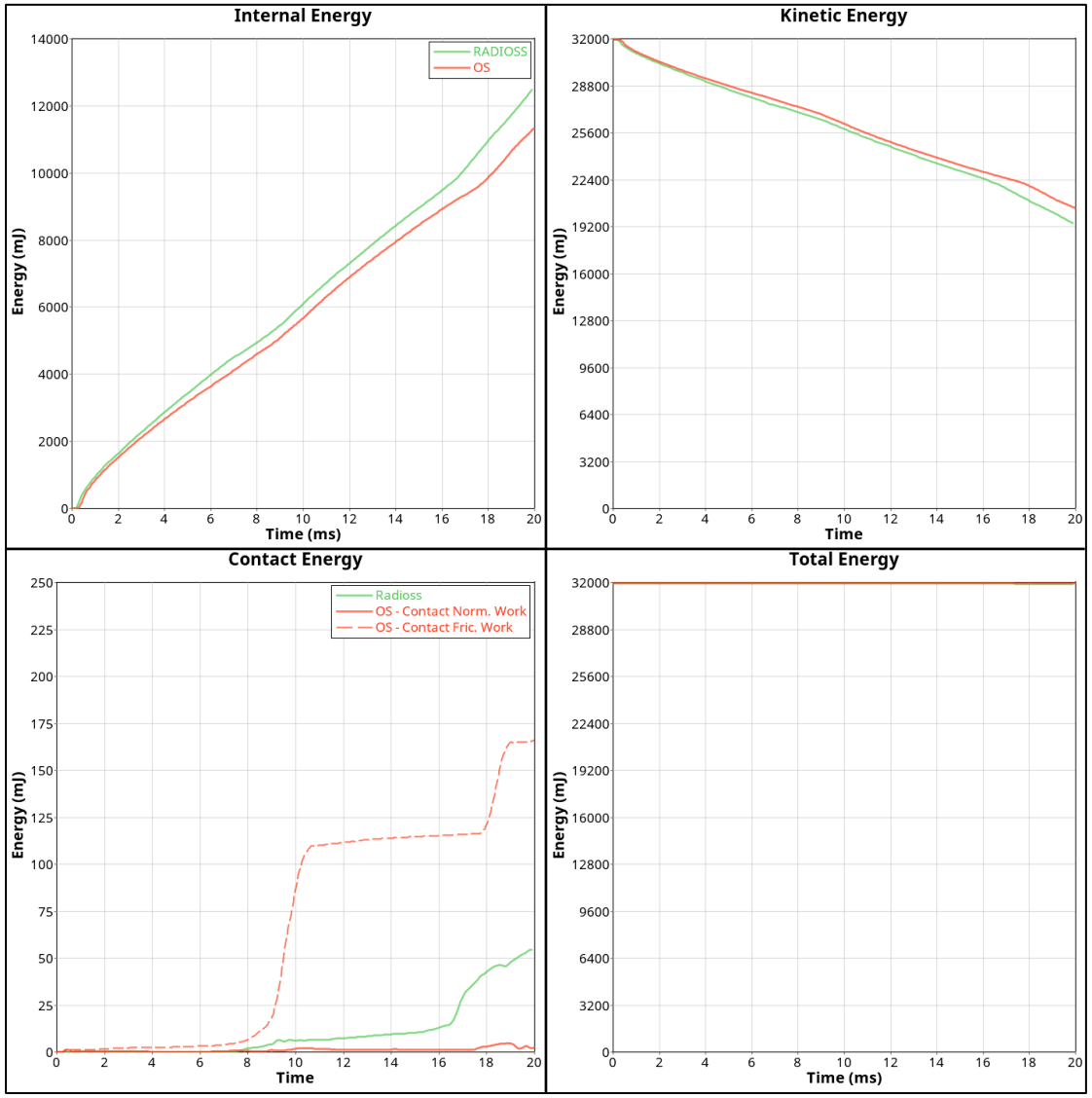
Simulation Results

Reduced Integration 5pts



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SENSITIVITY STUDY

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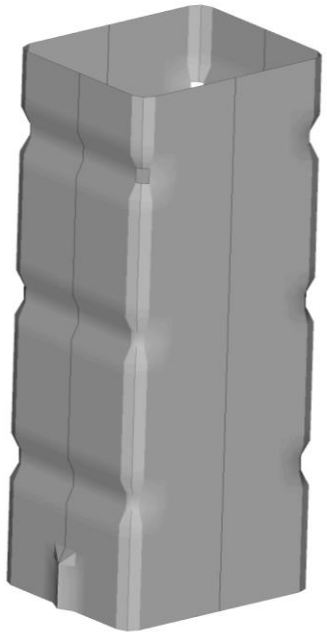
Sensitivity Study

Objectives

- A sensitivity study wrt number of cores is conducted.
- The OptiStruct Reduced Integration model with 5 integration points through the thickness is used.
- The following configurations have been tested: 1 CPU, 2 CPU, 4 CPU, 8 CPU, 12 CPU.
- The performances (runtime) are not analyzed. There are not enough elements (2000) in the model to have relevant assessment of the parallelization efficiency.



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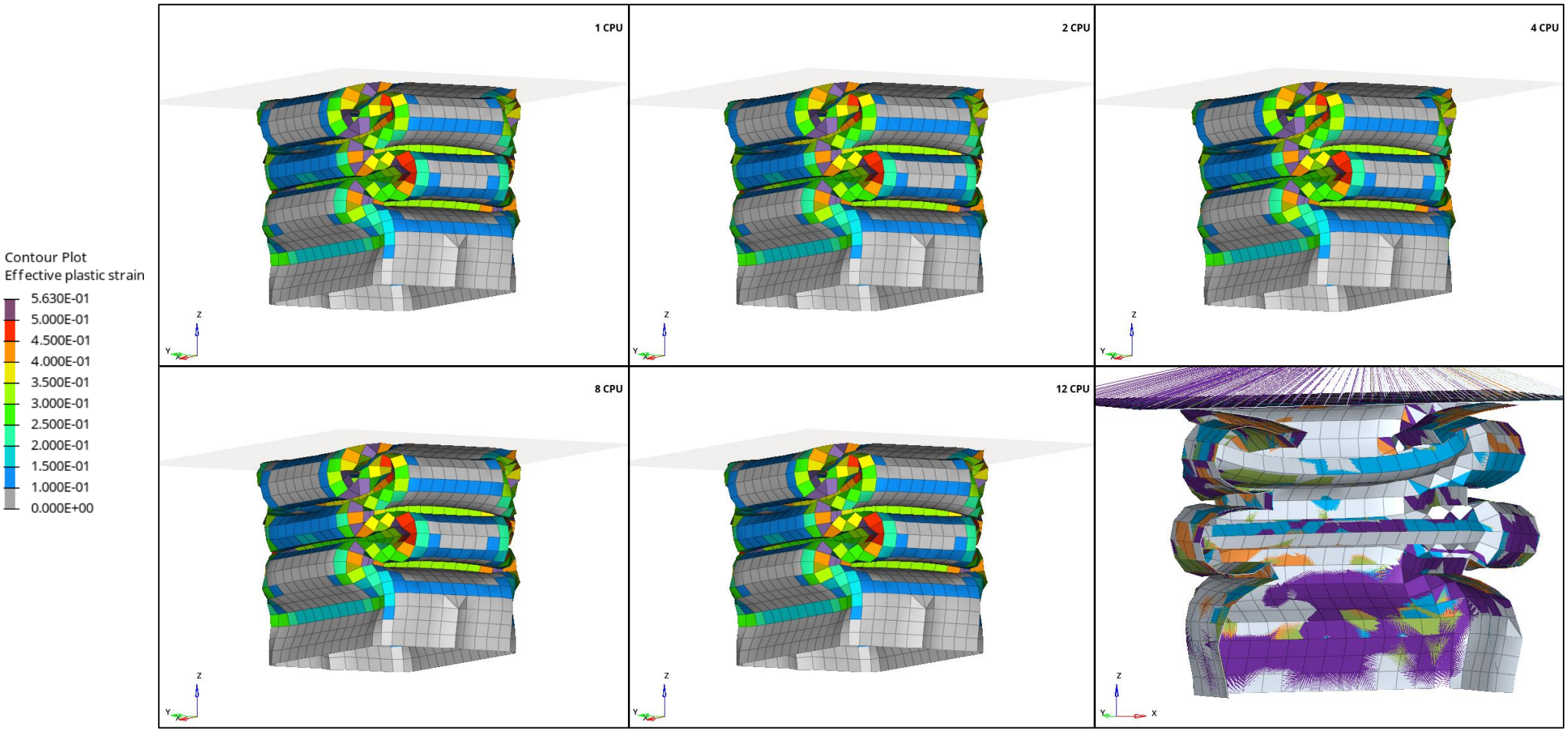
Sensitivity Study

Simulation Results



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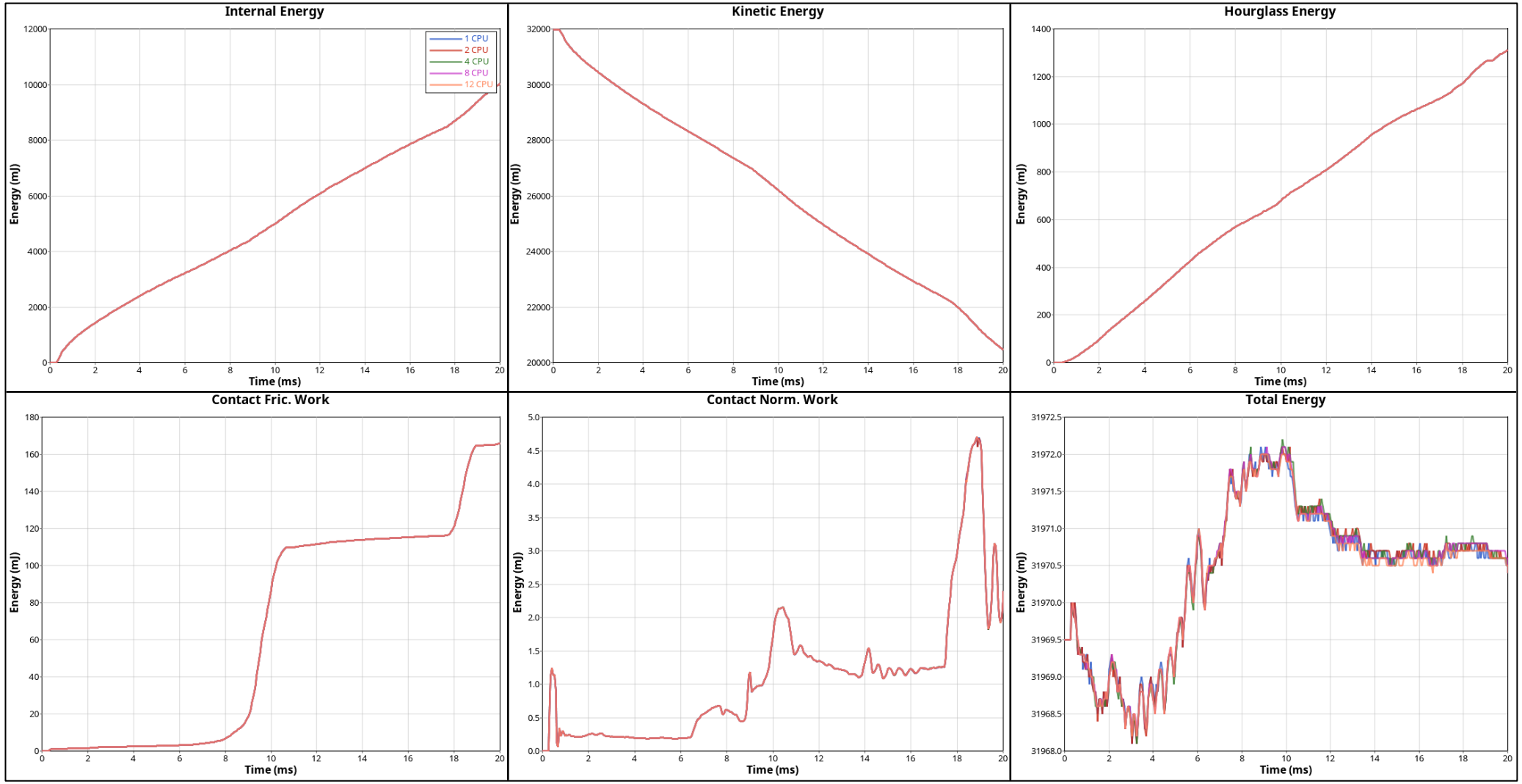
Sensitivity Study

Simulation Energy levels



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CONCLUSION

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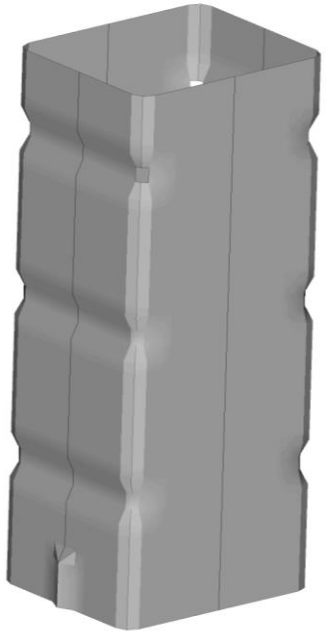
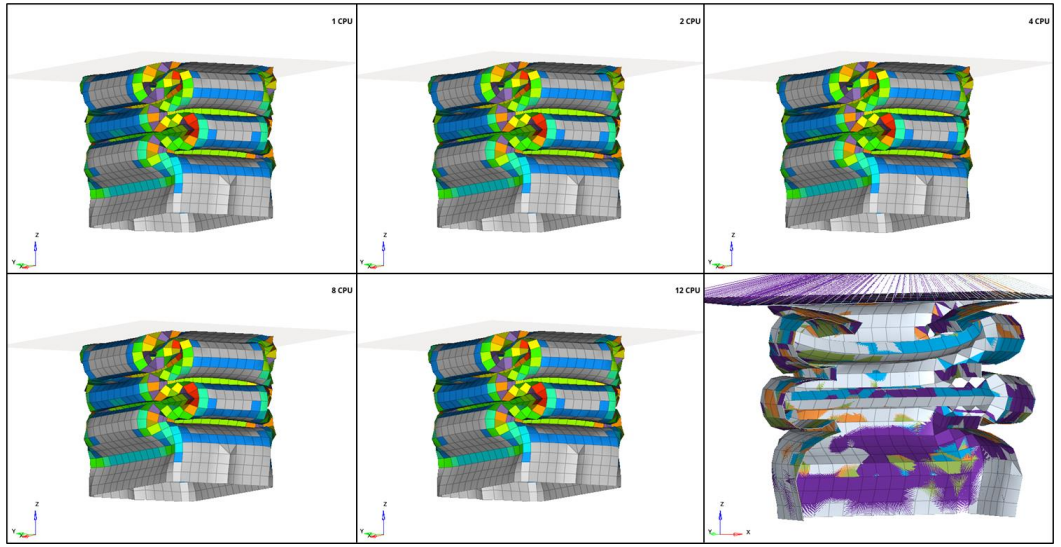
Outlook

- This study showcases Radioss capabilities OptiStruct capabilities in structural explicit analysis.
- Different integration schemes have been evaluated.
- Comparisons have been conducted between Radioss & OS explicit. Results are consistent between the two softwares.
- A sensitivity study wrt number of cores has been conducted. Results are not sensitive to the number of cpus used, which is good.



Crash box Simulation Results



Sensitivity Study Results

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