Can Test Report

root

December 7, 2020

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Abstract

This report is about the numerical simulation of a crushed can.

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Chapter 1

Introduction

This sample report illustrates the automatic report generator (ARG).
We simply recall that the *equivalent plastic strain rate* is defined as follows:

$$\dot{\bar{\epsilon}} = \sqrt{\frac{2}{3}\dot{\epsilon_{ij}}^p \dot{\epsilon_{ij}}^p},$$

where $\dot{\epsilon_{ij}}^p$ is the *plastic strain rate*.

Chapter 2

The Can Case

2.1 Model Meta-Information

This section provides an overview of the data set used for this analysis.

item	number
Exodus II files	1
element blocks	2
element fields	1
elements	7152
node fields	3
node sets	2
nodes	10088
side sets	1
time-steps	44

Table 2.1: Topological properties of `can.ex2`

block ID	block name
1	Unnamed block ID: 1
2	Unnamed block ID: 2

Table 2.2: Element blocks of `can.ex2`

node set ID	node set name
1	Unnamed set ID: 1
100	Unnamed set ID: 100

Table 2.3: Node sets of `can.ex2`

side set ID	side set name
4	Unnamed set ID: 4

Table 2.4: Side sets of `can.ex2`

variable	type
ACCL	NODAL
DISPL	NODAL
VEL	NODAL
EQPS	ELEMENT
KE	GLOBAL
NSTEPS	GLOBAL
TMSTEP	GLOBAL
XMOM	GLOBAL
YMOM	GLOBAL
ZMOM	GLOBAL

Table 2.5: Variables of `can.ex2`

2.2 Mesh Blocks

This section provides a description of all blocks contained in the mesh `mesh/crush_assembly.g`.

Block 1 (Unnamed block ID: 1) summary

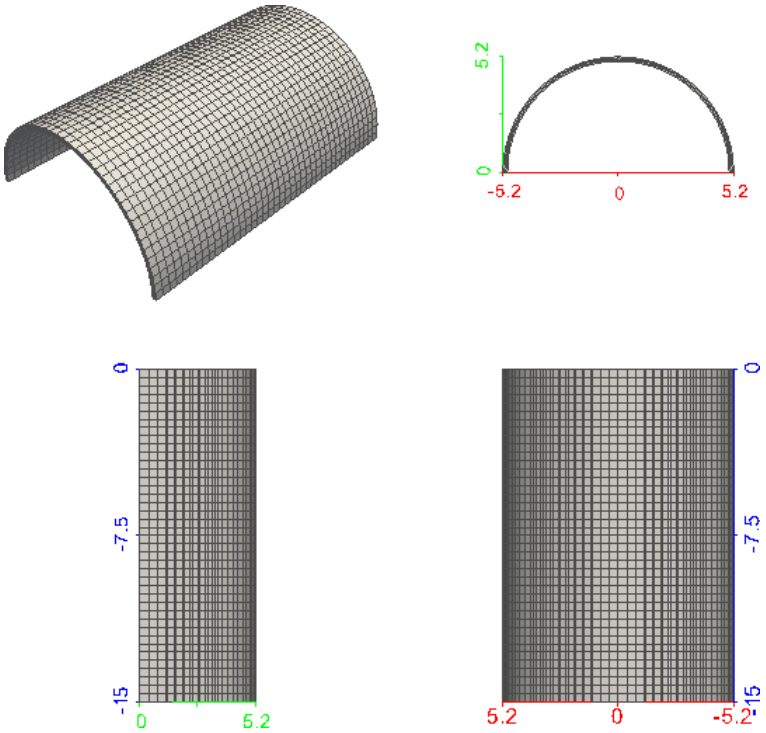

Figure 2.1: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) rendering of block 1.

property	value
number of nodes	6724
number of elements	4800
type of first element in block	HEX8

Table 2.6: Properties of block Unnamed block ID: 1.

Block `1` (`Unnamed block ID: 1`) element quality

$\mathcal{Q}$	$\min(\mathcal{Q})$	$\mu(\mathcal{Q})$	$\max(\mathcal{Q})$	$\sigma(\mathcal{Q})$	$\sigma/\mu(\mathcal{Q})$
scaled Jacobian	0.9992	0.9992	0.9992	0	0
shape	0.4525	0.4549	0.4572	0.00188	0.004134

Table 2.7: Element quality statistics of block `Unnamed block ID: 1`.

Histogram of scaled Jacobian element quality in block `Unnamed block ID: 1` is too narrow to be inserted (coefficient of variation: $0.0 < 0.001$).

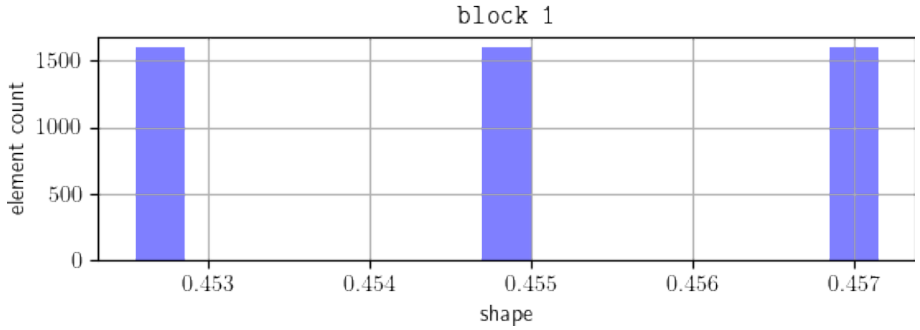

Figure 2.2: Histogram of shape element quality in block `Unnamed block ID: 1`.

Comment by Author: This block represents only one half of a can in order to simplify the simulation.

Block 2 (`Unnamed block ID: 2`) summary

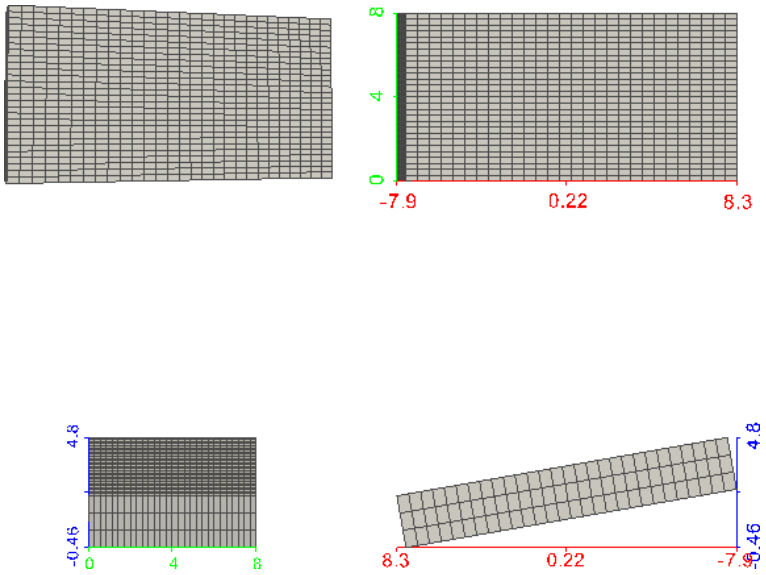

Figure 2.3: Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) rendering of `block 2`.

property	value
number of nodes	3364
number of elements	2352
type of first element in block	`HEX8`

Table 2.8: Properties of block `Unnamed block ID: 2`.

Block 2 (Unnamed block ID: 2) element quality

$\mathcal{Q}$	$\min(\mathcal{Q})$	$\mu(\mathcal{Q})$	$\max(\mathcal{Q})$	$\sigma(\mathcal{Q})$	$\sigma/\mu(\mathcal{Q})$
scaled Jacobian	1	1	1	0	0
shape	0.7197	0.7197	0.7197	2.148e-07	2.984e-07

Table 2.9: Element quality statistics of block Unnamed block ID: 2.

Histogram of scaled Jacobian element quality in block Unnamed block ID: 2 is too narrow to be inserted (coefficient of variation: $0.0 < 0.001$).
Histogram of shape element quality in block Unnamed block ID: 2 is too narrow to be inserted (coefficient of variation: $2.9841980535307454\text{e-}07 < 0.001$).

Explanation: This block represents a plate used to crush the can.

2.3 Visualizations of Some Available Attributes

2.3.1 Surface Renderings of Initial State

We begin by presenting some surface renderings of the data set for several of its scalar or vector attributes, at the initial time step $t = 0$.

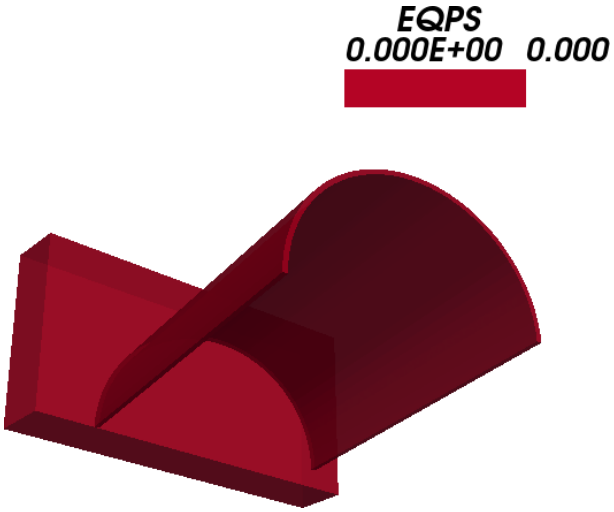

Figure 2.4: Translucent surface rendering of `can.ex2` at time step 0.

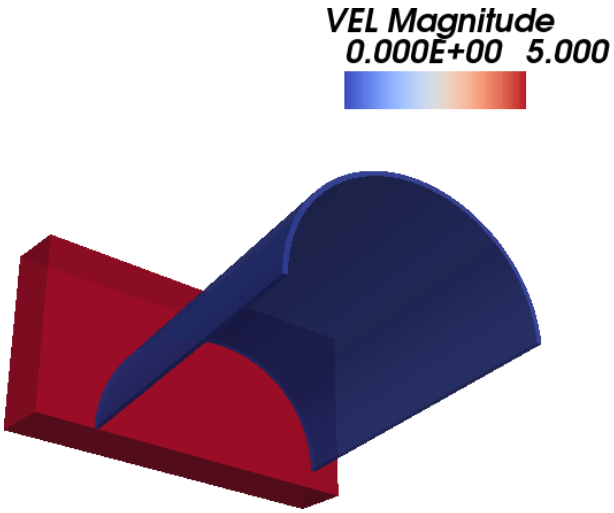

Figure 2.5: Translucent surface rendering of `can.ex2` at time step 0.

2.3.2 Surface Renderings at Intermediate Time Step

We continue with some depictions of the same data set, half-way through the simulation.

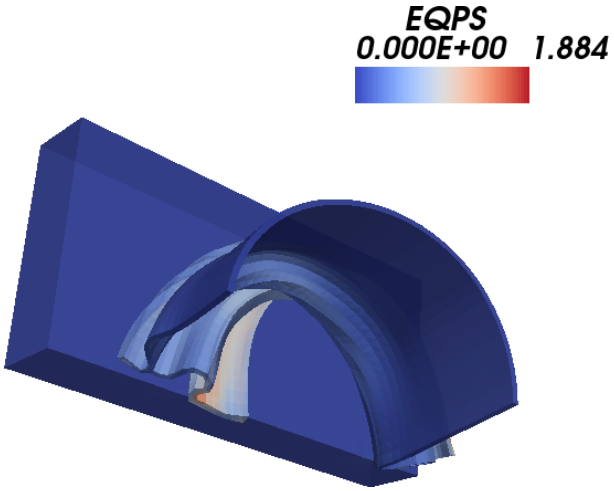

Figure 2.6: Translucent surface rendering of `can.ex2` at time step 21.

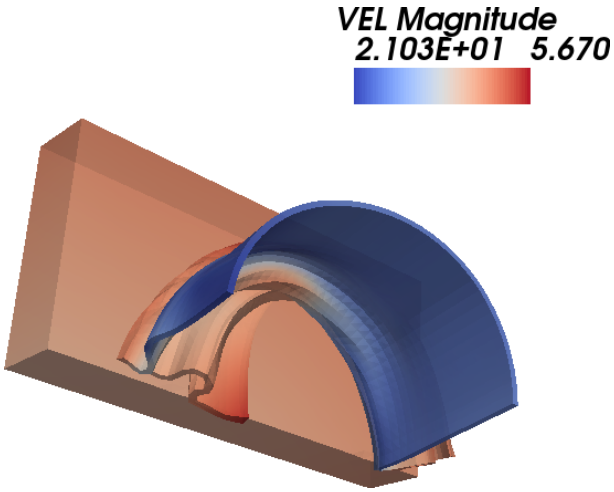

Figure 2.7: Translucent surface rendering of `can.ex2` at time step 21.

2.3.3 Surface Renderings of Final State

We conclude with renditions of the final state of the simulation.

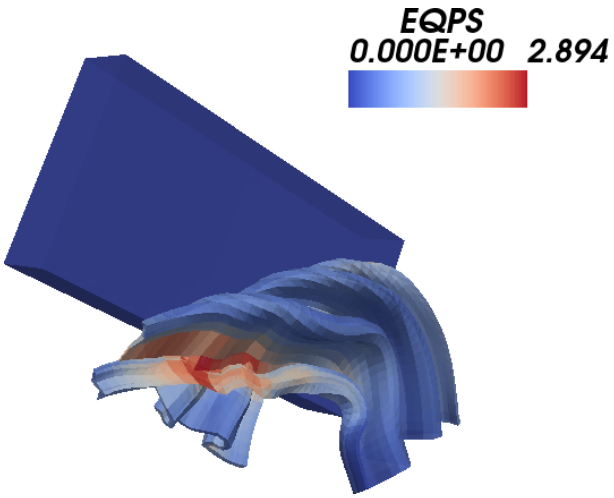

Figure 2.8: Translucent surface rendering of `can.ex2` at time step 43.

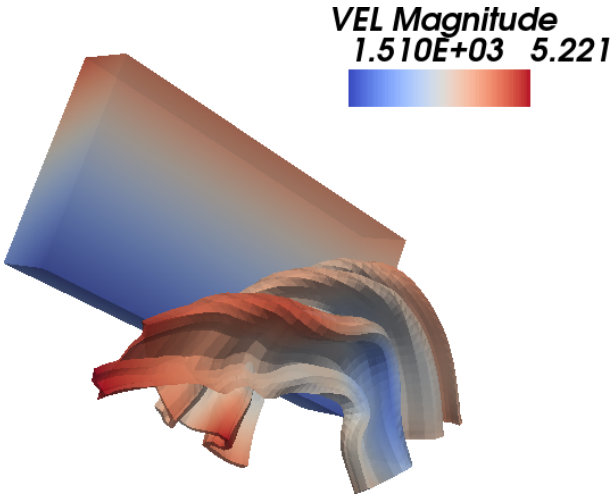

Figure 2.9: Translucent surface rendering of `can.ex2` at time step 43.

Chapter 3

Results

This chapter describes key results of the analysis workflow instance.

3.1 Quantities of Interest; Margins

Requirements:

- Tensile yield stress is 20000 psi.
- Required factor of safety is 3.

Calculated Performance:

- The calculated maximum nodal projected Mises stress is 7904.79 psi.
- The calculated normalized margin of maximum von Mises stress is -0.062.