ALTAIR

kitware

Introduction to OpenRadioss™ and ParaView

Marian Bulla - Director - OpenRadioss Community
François Mazen - Director - Scientific Visualization

8th of October 2024

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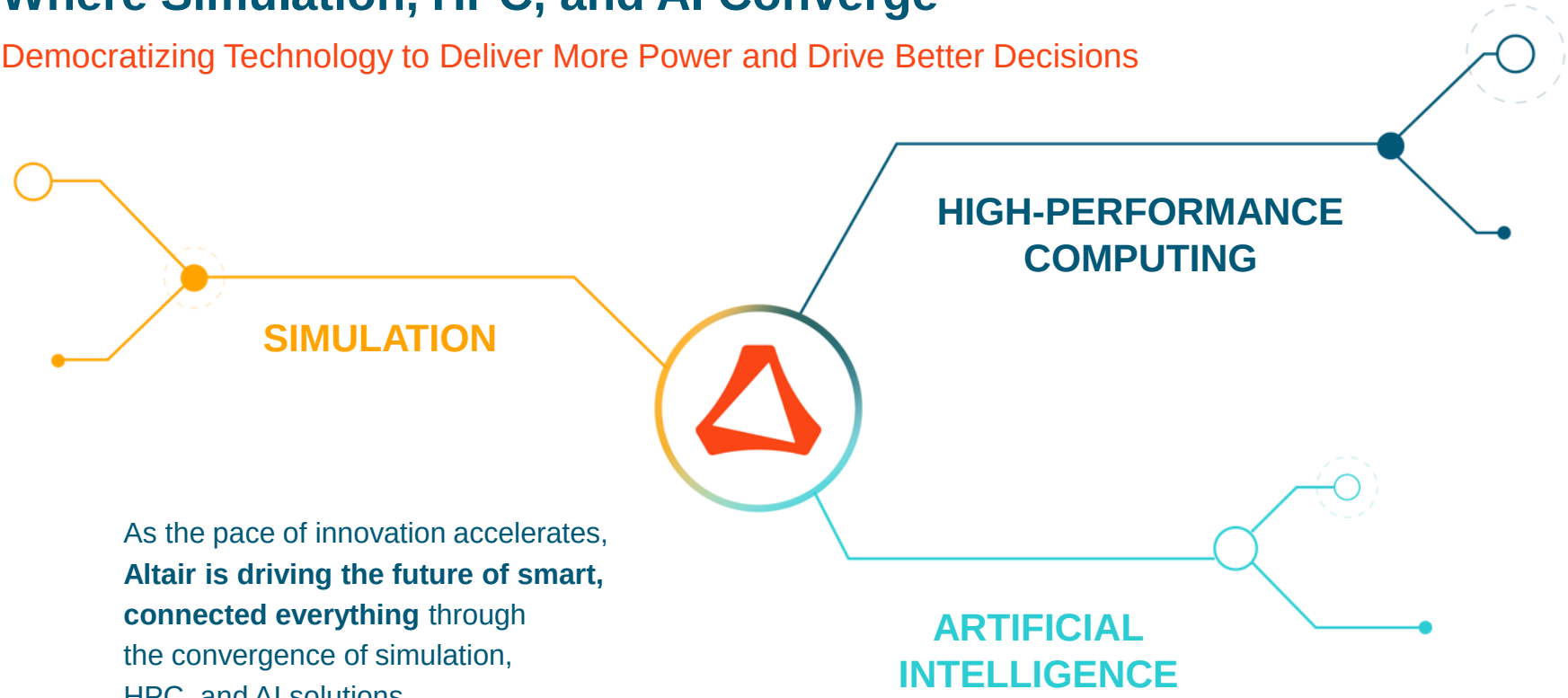
Where Simulation, HPC, and AI Converge

Democratizing Technology to Deliver More Power and Drive Better Decisions



As the pace of innovation accelerates, **Altair is driving the future of smart, connected everything** through the convergence of simulation, HPC, and AI solutions.

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Altair’s Vision

Computational intelligence will drive innovation for a more connected, safe, and sustainable future

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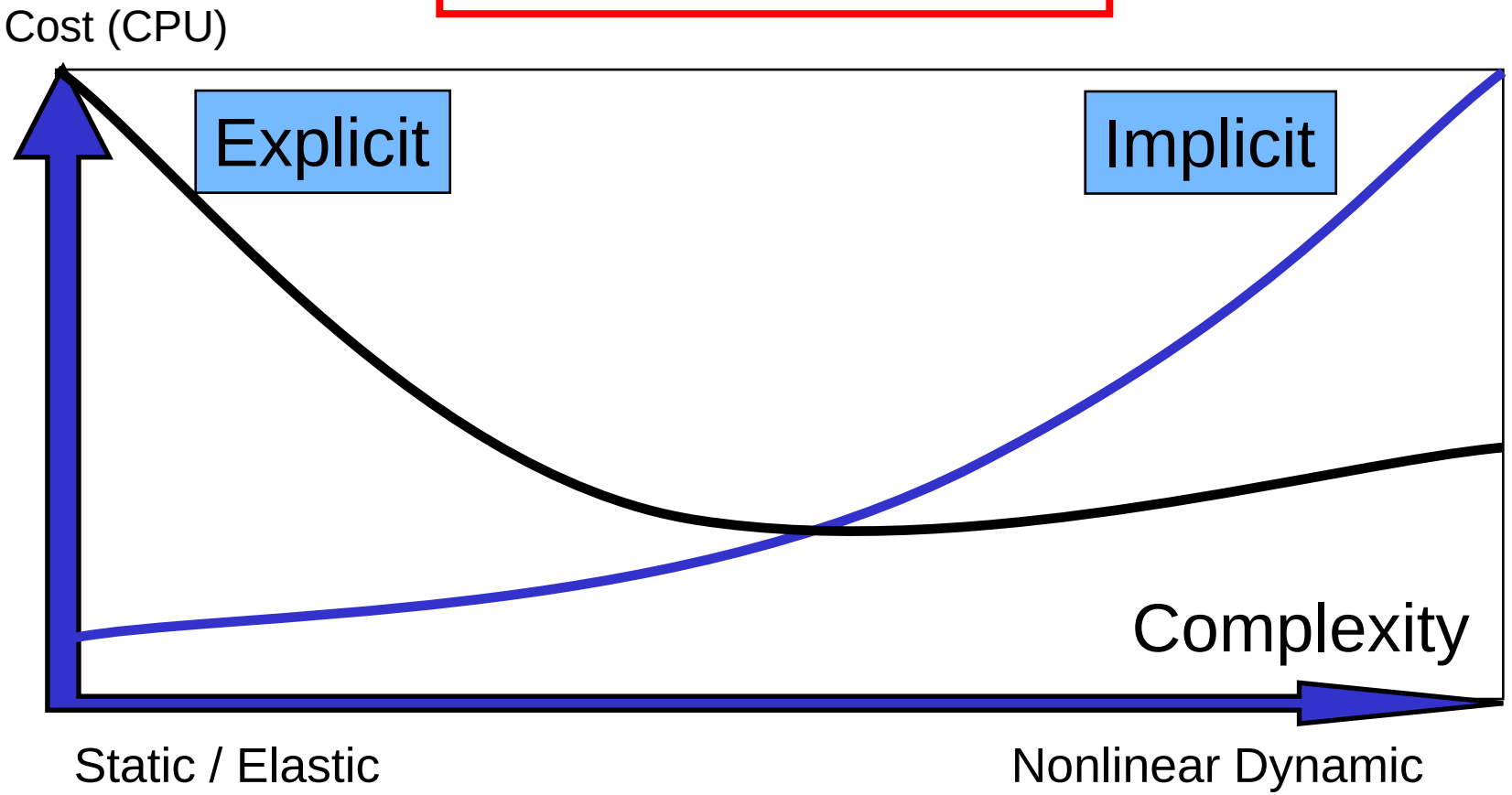
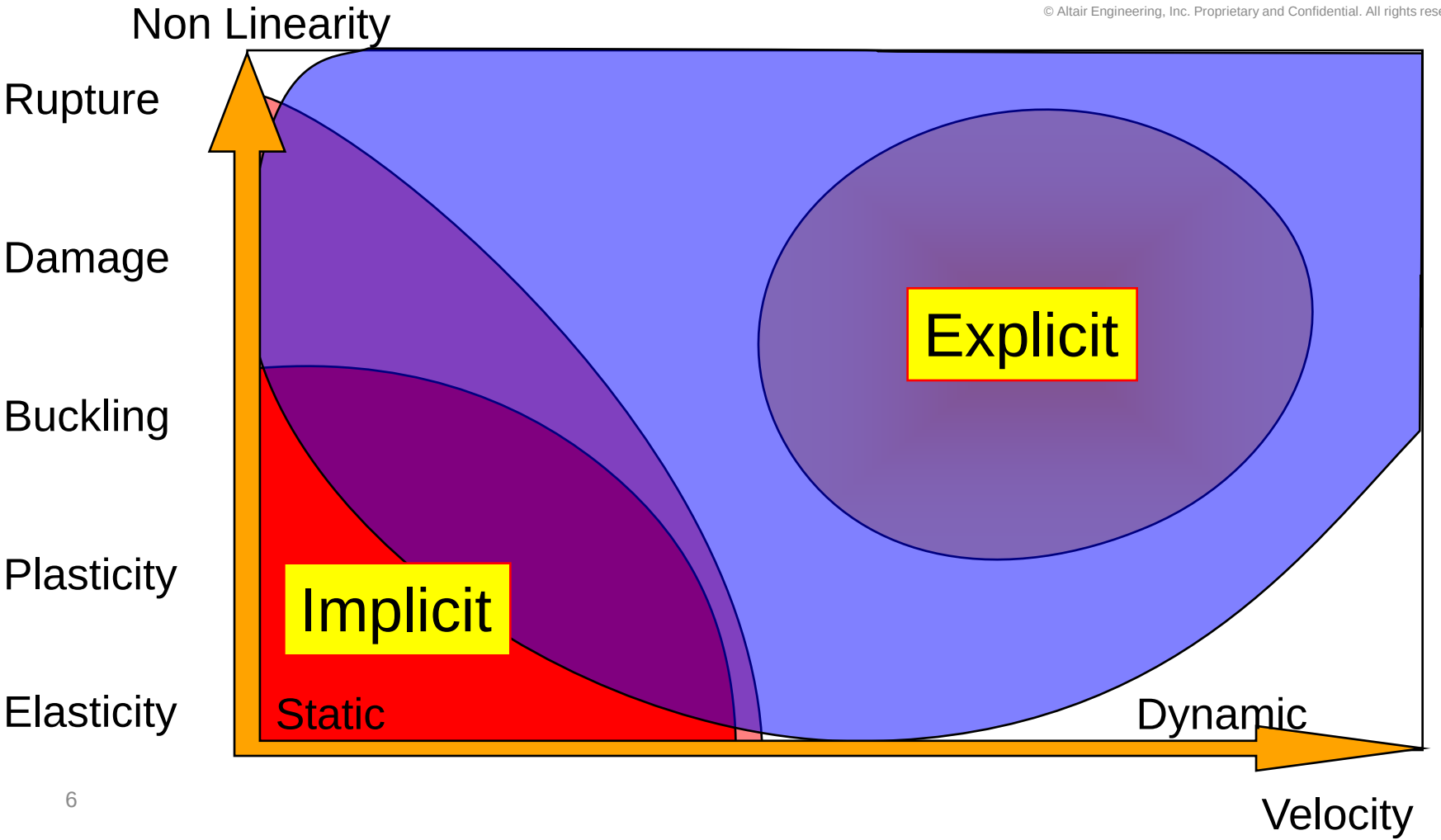
Little bit of Theory… Implicit Method

$$[K]\{X_n\} = \{F_{ext}(t_n)\}$$

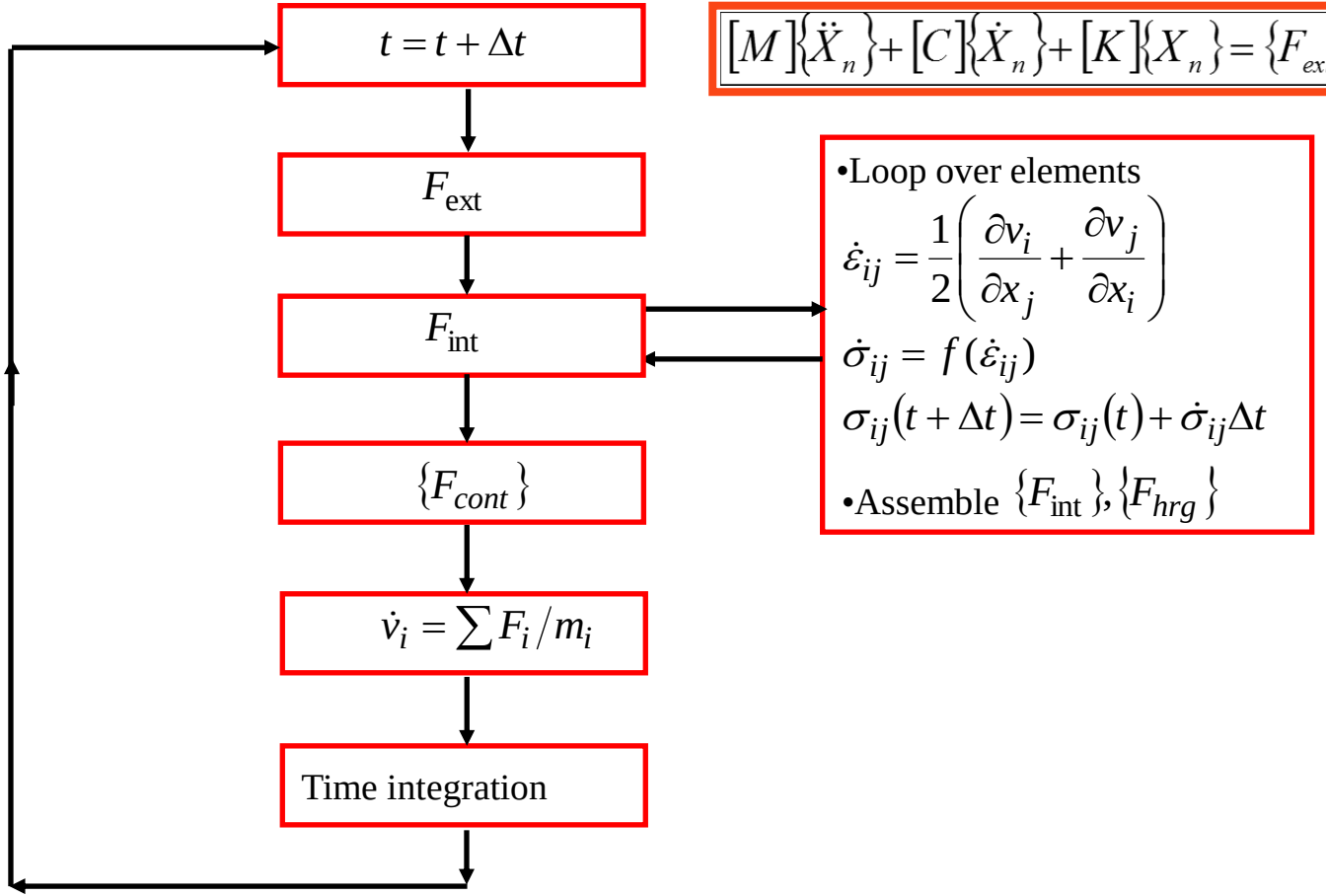


Little bit of Theory…



Explicit Flow Chart

$$[M]\{\ddot{X}_n\}+[C]\{\dot{X}_n\}+[K]\{X_n\}=\{F_{ext}(t_n)\}$$



INTRODUCTION TO RADIOSS

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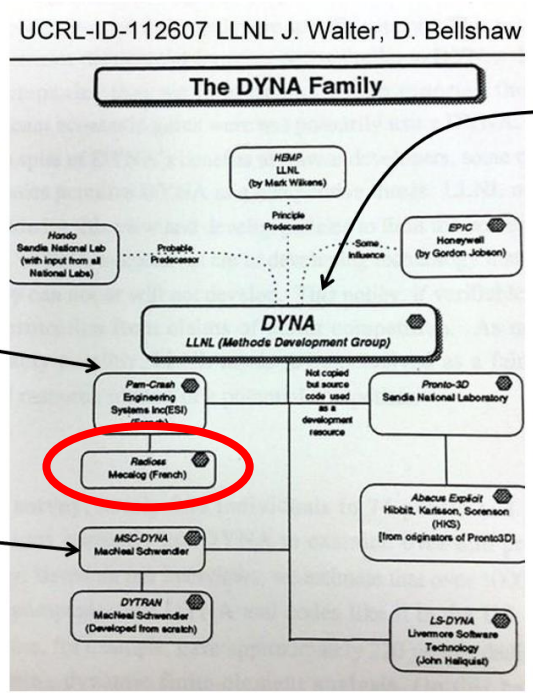
Little bit of History…

PDB

Explicit FE codes were available in the mid ‘70s (DYNA3D : 1976)

WHAMS
Northwestern/Argonne
Chicago IL

PISCES
Pisces International
San Leandro CA
explicit FVM CFD
H. Hancock



W.F. Noh
CEL
First coupled EL code
LLL, 1964

SAND86-0594
SNL, march 1987
Albuquerque NM.
L. Taylor & D. Flanagan

Source: **Paul Du Bois**: Presentation at the OpenRadioss Users meeting 2023 in Aachen (Germany)

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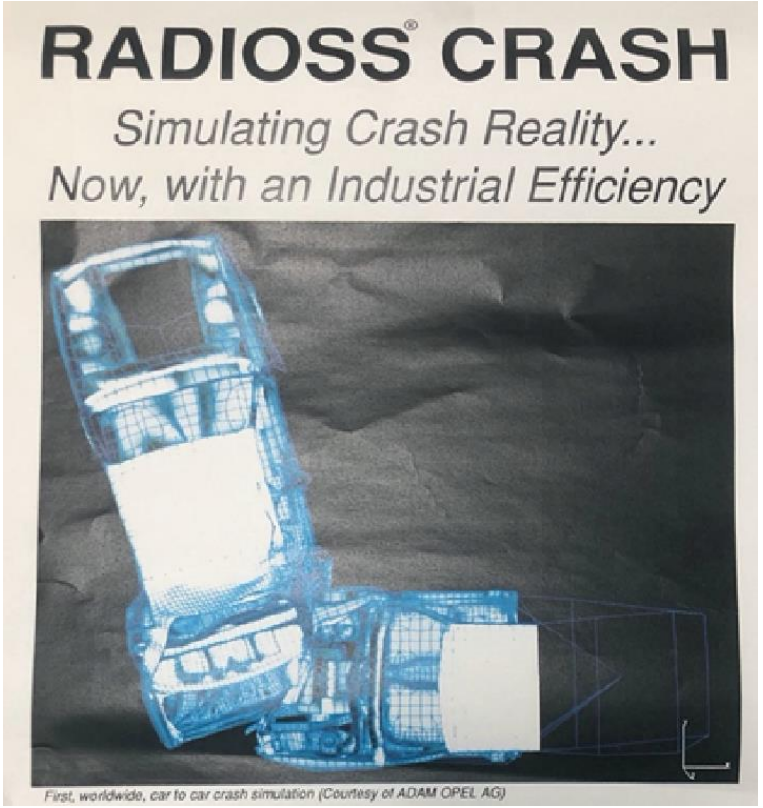
Little bit of History…

Industrial car crash simulations emerged in the mid 80th
driven by a small community of talented enthusiasts
that rapidly perceived the huge benefit
to replace physical testing by computer simulations.

For instance, the first, worldwide,
car to car crash simulation was run with Radioss in 1991.

With progress made on computer science,
usage democratized and 30 years later,
legacy codes like Radioss are extensively used for crash
and impact in many industries,
including automotive, defense, aerospace, railway,
but also electronics and consumer goods, biomechanics…



First, worldwide, car to car crash simulation (Courtesy of ADAM OPEL AG)

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Introducing OpenRadioss™

Altair® Radioss® simulation platform goes open source

Proprietary crash code development can no longer keep up with the rapid transformation in transportation industries.

Our Vision

- **Accelerate innovation** in the research community – tremendous benefits consolidating activities around an industry proven code
- Maximize immediate synergy between **leading edge research and industry frontiers**
- Build a highly engaged and inclusive **open-source community** involving researchers, software developers, engineers, educators
- Facilitate **knowledge and model exchange**, enabling development of advanced safety and bio-medical models
- **Ensure the future**, advancing FEA technology and modernizing software platform

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OpenRadioss – Accelerate Innovation

R&D Collaborations in Strategic Domains

Materials and failure models

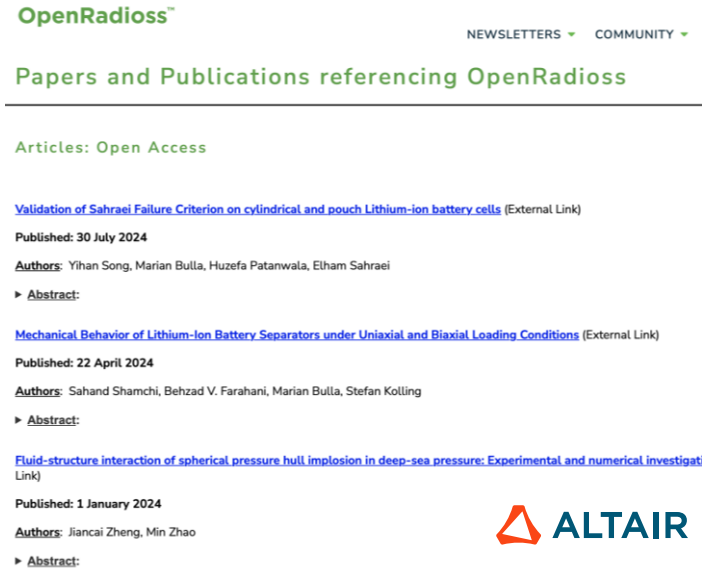
- Damage & materials models, for battery, glass, concrete, composite, tire, …

Biomechanics for Healthcare & Safety

- THUMS, Piper, Viva+, THOR

Software Performance

- Hardware, software & cloud providers
- AI and Machine Learning to speedup computation



OpenRadioss™ – The Open-Source Version of Radioss

Democratize usage of explicit dynamics, build an active community and accelerate innovation pace

Introduced 2 years ago…

Connections to www.openradioss.org
statistics by country, at launch time, Sept-22

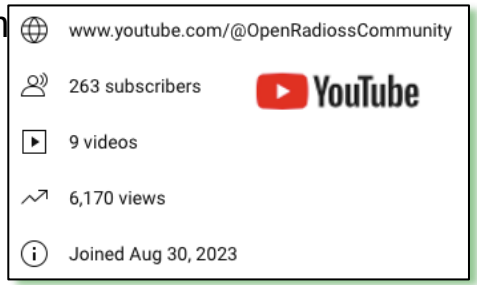
Country	Connections
India	10 k
United States	9,4 k
China	4,1 k
Japan	2,2 k
Germany	
Brazil	
United Kingdom	

Total

Fast growing since then!

GitHub.com/OpenRadioss statistics:

- 12000+ binary downloads
- 250+ forks & 2500+ contributions, including 100+ code fixes
- 250+ discussion subjects on forum



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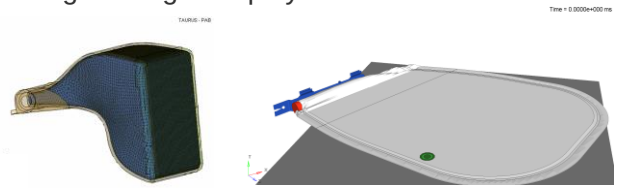
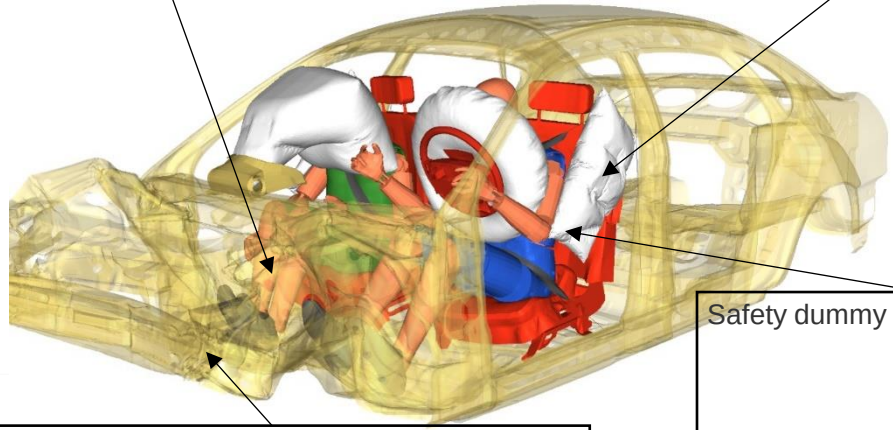
What is Radioss ?

Crash & Safety in Automotive

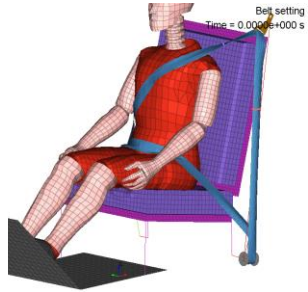
Failure risk assessment:

Airbag Folding & Deployment:

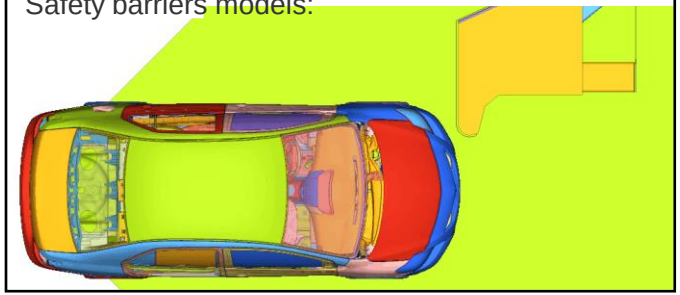




Safety dummy models:



Safety barriers models:



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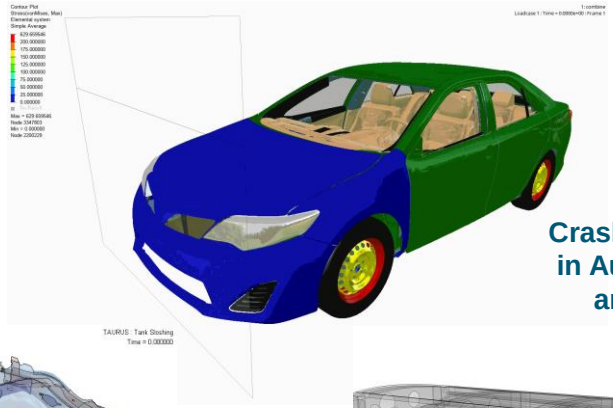
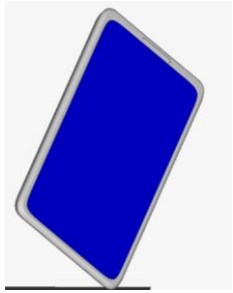
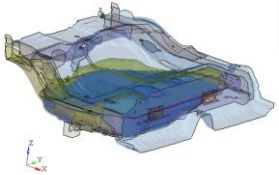
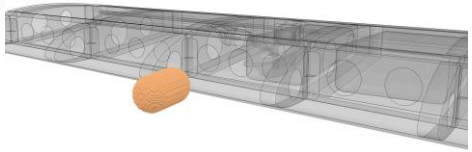
Altair® Radioss® – Proven Crash & Impact Simulation Software



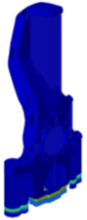
Crash & Safety in Auto, Aero and Rail

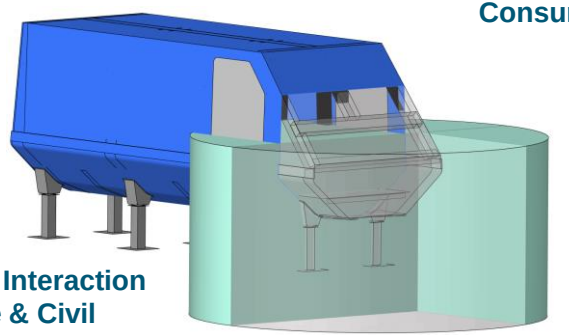






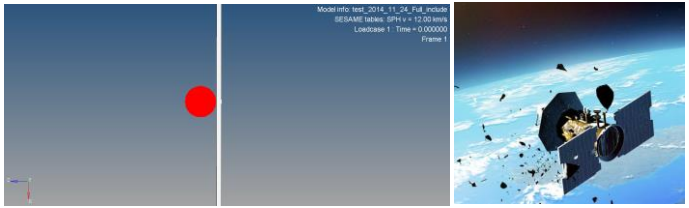
Drop & Impact in Electronics and Consumer Goods

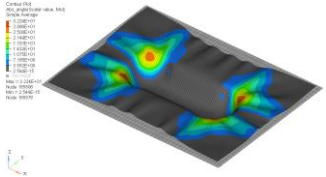




Fluid Structure Interaction for Defense & Civil

Forming & Manufacturing





Large Scale Computing and Parallelization

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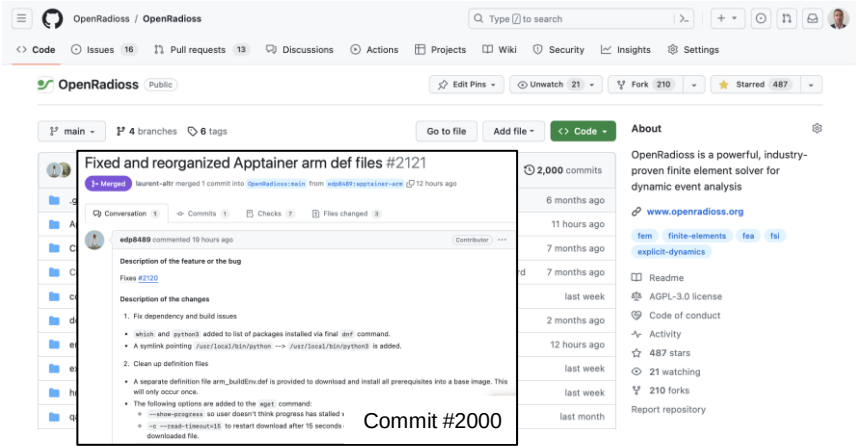
Altair® Radioss® & OpenRadioss™
The Industry Standard Open Platform for Crash & Impact

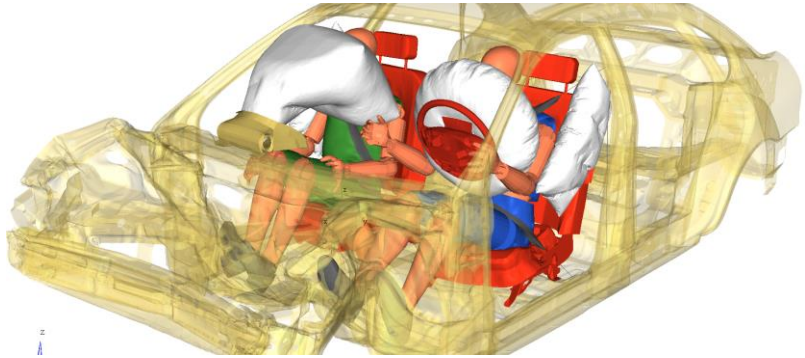
OpenRadioss™ Open-Source Version

- Source code publicly accessible from: https://github.com/OpenRadioss
- Upstream version, with contributions from a fast-growing worldwide community
- Precompiled Linux & Windows executables to run latest builds with no license check
- Support from the community, via forum



Altair® Radioss® Commercial Version

- Commercial releases with extensive QA, professional support, documentation and maintenance priority
- Available under Altair Units license
- Encrypted models for dummies & barriers
- Channels valuable community contributions into industrial release



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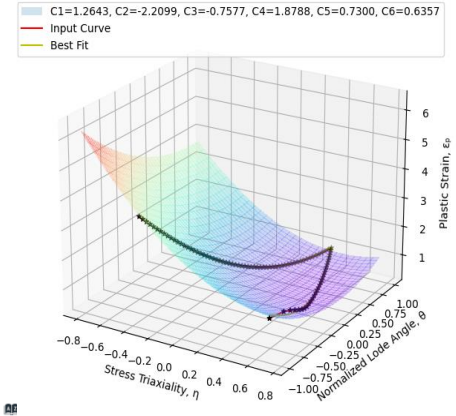
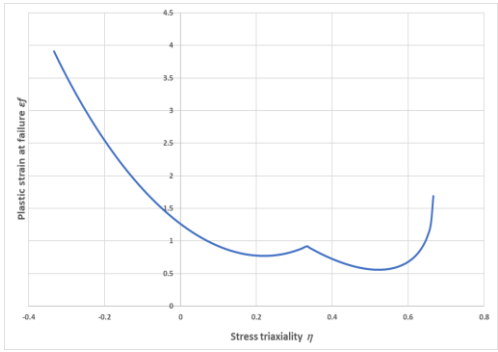
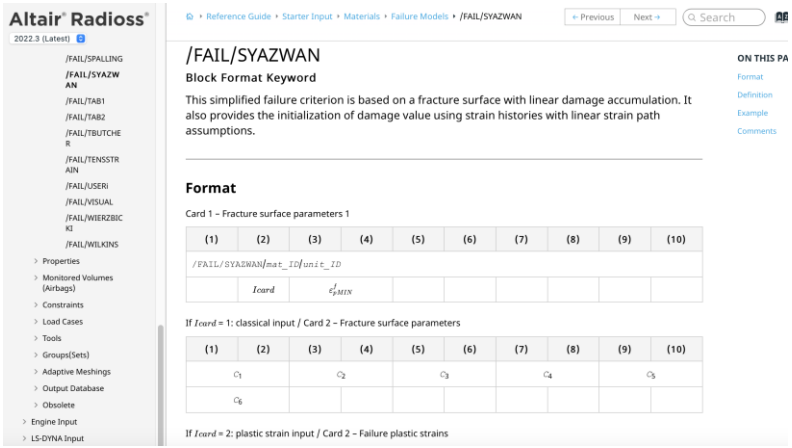
Altair Radioss & OpenRadioss – /FAIL/SYAZWAN Example





Example of SYAZWAN failure criterion fit



Originally developed in OpenRadioss

Released in Altair Radioss 2022.3

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OpenRadioss Users Day 2023

OpenRadioss user meeting: FH Aachen, University of Applied Science: Aachen, June 27th, 2023

Archive of the event proceedings

OpenRadioss Technical Presentations

From the Aachen user meeting: June 27th, 2023

Eric Lequiniou | Altair
Senior Vice President, Radioss Development

Opening of The 2nd OpenRadioss Users Meeting

Prof. Dr.-Ing Peter Dahmann
Prof. Dr.-Ing. Thilo Röth | FH Aachen University

Keynote Presentation: Todays FEM-Education at FH Aachen and living Altair-Cooperation

Vincent Dampure | Altair
Product Manager, Crash

HyperWorks for Radioss Structural Impact and Vehicle Safety Applications

Daniel Campos Murcia | DatapointLabs
CAE Engineer

Beyond Standards:
Material Testing and Processing for Successful Simulations of Foam Materials

Paul Du Bois
Independent Engineer

Challenges in Material Modeling of Metals and Polymers

David Lecomber | ARM
Senior Director, HPC

The Development of OpenRadioss Support for Arm (CMB)

Björn Adamski | CIQ
Managing Director, EMEA

Fast-track to OpenRadioss with Rocky Linux on Oracle Cloud

Dr. Robert Bollig | Cornelis Networks
HPC Solution Architect

Delivering Leadership Performance with Open-Source Software: OpenRadioss™ and Cornelis™ Omni-Path Express™

Kang Zhao | Simright
CEO

Input Format Conversion of OpenRadioss: Practice and Use Cases

Dr. Axel Haenschke | CPS Consulting
Senior Consultant, Head of Business Development, MBSE

The Tool-set to Implement the Virtual Tire Lab in The Altair Environment

Saullo G.P. Castro | Delft University of Technology
Associate Professor Aerospace Structures & Materials

Challenges and Current Developments Towards Design for Crashworthiness

Pierre-Jean Arnoux | LBA & Gustave Eiffel University
Director and Research Director

Virtual Human Modeling for Health Applications

Robert O'Bara | Kitware, Inc.
Senior Consultant, Head of Business Development, MBSE

Supporting End-to-End Simulation Workflows Using Computational Model Builder (CMB)
CMB Kitware

Elham Sahraei | Temple University
Associate Professor & Director of Electric Vehicle Safety Lab

Modeling Deformation and Failure of Lithium-ion Batteries Using OpenRadioss

Lukas Laarmann | FH Aachen
Research Associate, Structural Design & Crash

Evaluation of eVTOL Crashworthiness using full-vehicle crash simulations

Audience : 150+ attendees (in-person + remote)

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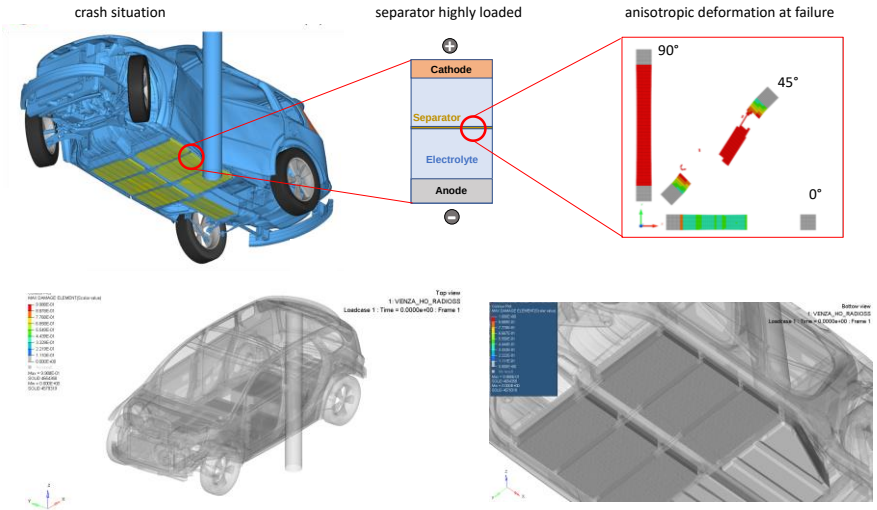
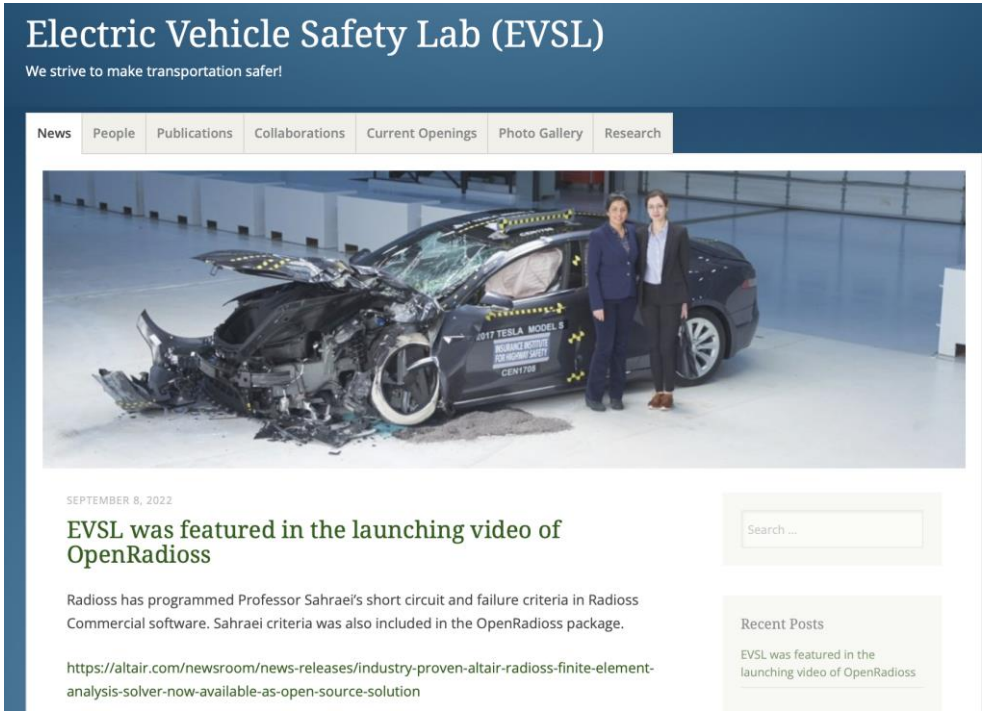
OpenRadioss Users Day 2024

Hosted by Professor Elham Sahraei

Temple University, Philadelphia

September 26th





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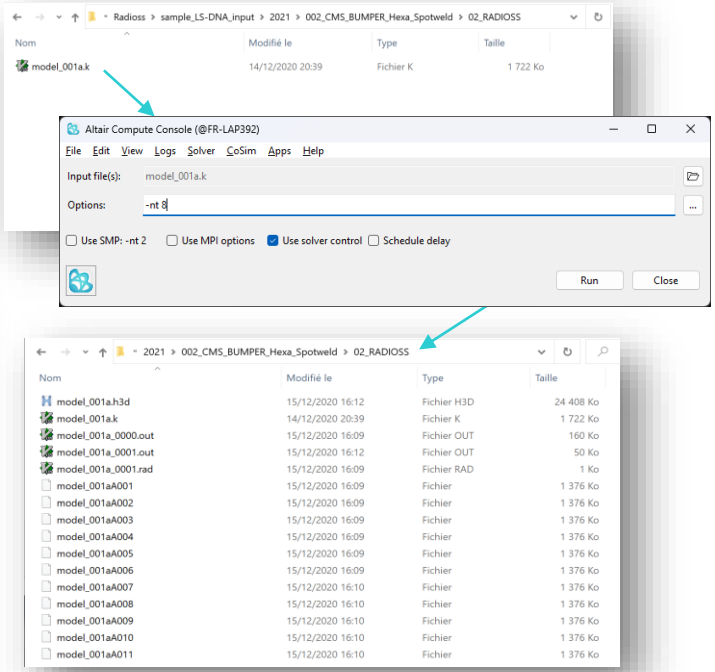
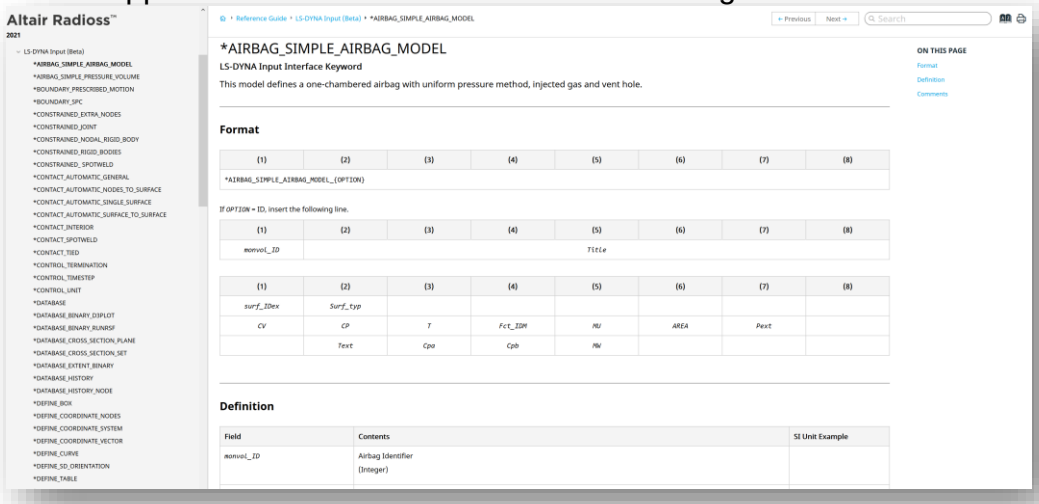
A transformational Change – Compatibility with LS-DYNA

Input compatibility: LS-DYNA input models directly read by Radioss

- Multi-year development: initial focus on crash & impacts
- Continuous improvement & expansion toward FSI
- Adapting Radioss to user needs and experience
- Mixed input format support
- Supported cards described in the Reference guide





OpenRadioss™

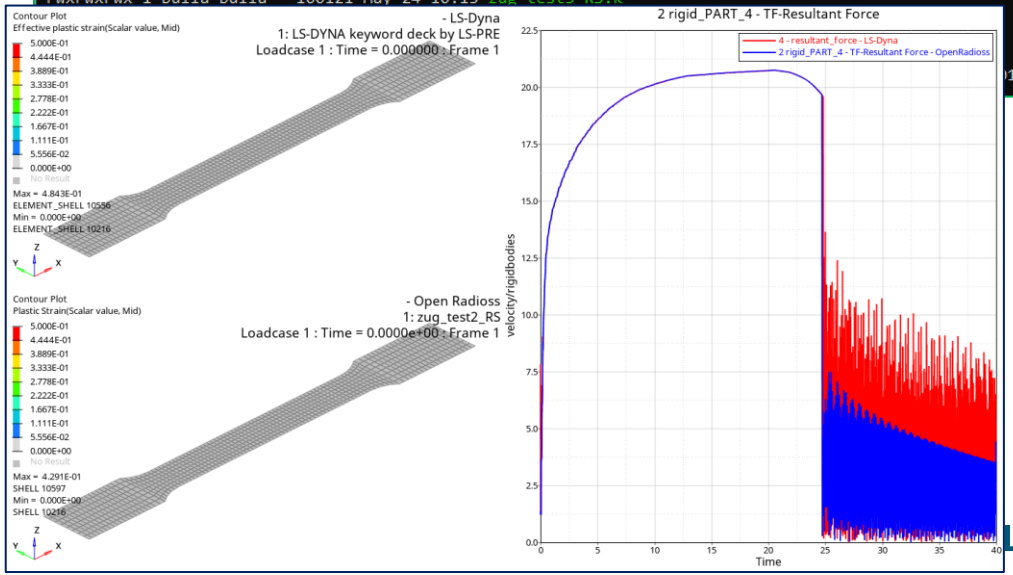
❖ Example: Using the LS-Dyna model format

```
bulla@DEWLT656:/mnt/d/WS/comparison/Dyna_wo_failure/DYNA2Rad$
bulla@DEWLT656:/mnt/d/WS/comparison/Dyna_wo_failure/DYNA2Rad$ ./starter_linux64_gf -i zug_test3_RS.k
************************************************************
**                                                        **
**                                                        **
**                    OpenRadioss Starter                 **
**                                                        **
**          Non-linear Finite Element Analysis Software   **
**                                                        **
**                                                        **
**                                                        **
**                  Linux 64 bits, GNU compiler           **
**                                                        **
**                                                        **
**                                                        **
**                                                        **
************************************************************
** OpenRadioss Software                                   **
** COPYRIGHT (C) 1986- Altair Engineering, Inc.           **
** Licensed under GNU Affero General Public License.      **
** See License file.                                      **
************************************************************

 .. READING LS-DYNA INPUT FORMAT MODEL

 .. UNITS SYSTEM
 .. CONTROL VARIABLES
 .. STARTER RUNNING ON    1 THREAD
```

zug_test3_RS.k

```
$$ HM_OUTPUT_DECK created 09:18:53 05-24-2022 by HyperMesh Version 2021.0.0.33
$$ Ls-dyna Input Deck Generated by HyperMesh Version  : 2021.0.0.33
$$ Generated using HyperMesh-Ls-dyna 971_R9.3 Template Version : 2021.0.0.33
*KEYWORD_ID 650000000
zug_test3_RS
$---+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
$                   (1) TITLE CARD.
$---+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
*TITLE
zug_test3_RS
*CONTROL_TERMINATION
$$  ENDTIM    ENDCYC     DTMIN    ENDENG    ENDMAS     NOSOL
      40.0
*CONTROL_TIMESTEP
$$  DTINIT    TSSFAC      ISDO    TSLIMT     DT2MS      LCTM     ERODE     MSIST
       0.0       0.9
$$  DT2MSF   DT2MSLC     IMSCL                         RMSCL
       0.0         0         0                             0
*CONTROL_SHELL
$$  WRPANG     ESORT     IRNXX    ISTUPD    THEORY       BWC     MITER      PROJ
      40.0         0        -1         1         2         2         1
$$ ROTASCL    INTGRD    LAMSHT    CSTYP6    THSHEL
       1.0         0         0         1
*CONTROL_HOURGLASS
$$      IHQ        QH
         1       0.1
*CONTROL_PARALLEL
$$    NCPU    NUMRHS      ACCU      PARA
         1         0         2
*CONTROL_OUTPUT
$$   NPOPT    NEECHO    NREFUP    IACCOP     OPIFS    IPNINT    IKEDIT    IFLUSH
         0         0         0         0       0.0         0       100      5000
$$   IPRTF     IERODE   TET10S8    MSGMAX    IPCURV      GMDT   IP1DBLT      EOCS
         0
*CONTROL_ENERGY
$$     HGEN      RWEN    SLNTEN     RYLEN
         2         2         2
*CONTROL_ACCURACY
$$      OSU       INN    PIDOSU      IACC
         0         2         0
$$DATABASE_OPTION -- Control Cards for ASCII output
*DATABASE_BNDOUT
$$      DT    BINARY      LCUR     IOOPT   OPTION1   OPTION2   OPTION3   OPTION4
      0.01         2
*DATABASE_ELOUT
$$      DT    BINARY      LCUR     IOOPT   OPTION1   OPTION2   OPTION3   OPTION4
      0.01         2
*DATABASE_GLSTAT
$$      DT    BINARY      LCUR     IOOPT
      0.01         2
*DATABASE_NODOUT
$$      DT    BINARY      LCUR     IOOPT      DTHF     BINHF
      0.01         2
*DATABASE_RBDOUT
$$      DT    BINARY      LCUR     IOOPT
```

```
-rwxr-xr-x 1 bulla bulla 26474992 May 20 16:21 engine_linux64_gf*
-rwxr-xr-x 1 bulla bulla 16520104 May 20 16:06 starter_linux64_gf*
-rwxrwxrwx 1 bulla bulla   160121 May 24 10:15 zug_test3_RS.k*
                                                              1.rad
```



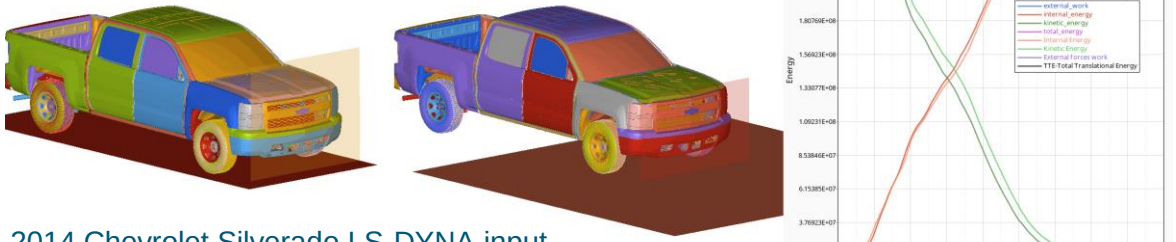
A transformational Change – Compatibility with LS-DYNA

Working towards output compatibility to seamlessly use Radioss in LS-DYNA workflow

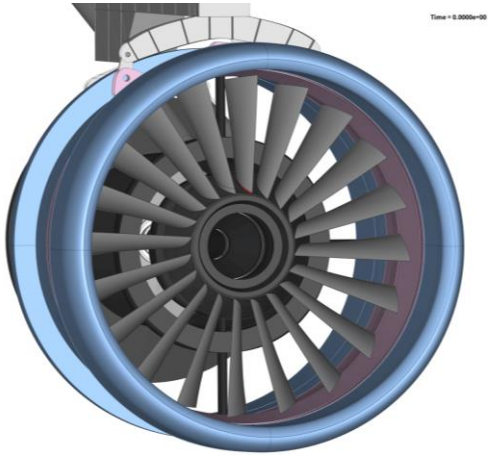
- D3plot support ***based on open-source community project***

Future plans

- Expand compatibility to Binout format
- HDF5 format
- Python interface



CCSA 2014 Chevrolet Silverado LS-DYNA input run with Radioss (right)



LS-DYNA input example from Aerospace Working Group (AWG) run with Radioss

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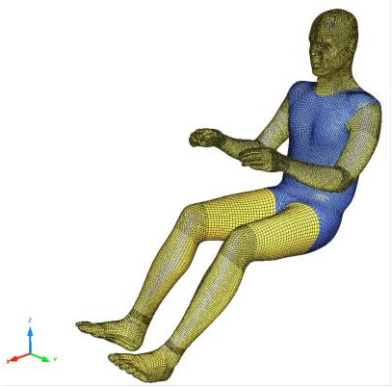
Human Body Models Collaborations

GHBMC Radioss version

Altair partners with Elemance & Virginia Tech University



Open-source models

Projects with the **OpenRadioss** community to support HBM for Auto & Rail, and Aero

THUMS AM50 & 6yo

Piper 6yo & Comfort

Aix*Marseille université

Université Gustave Eiffel

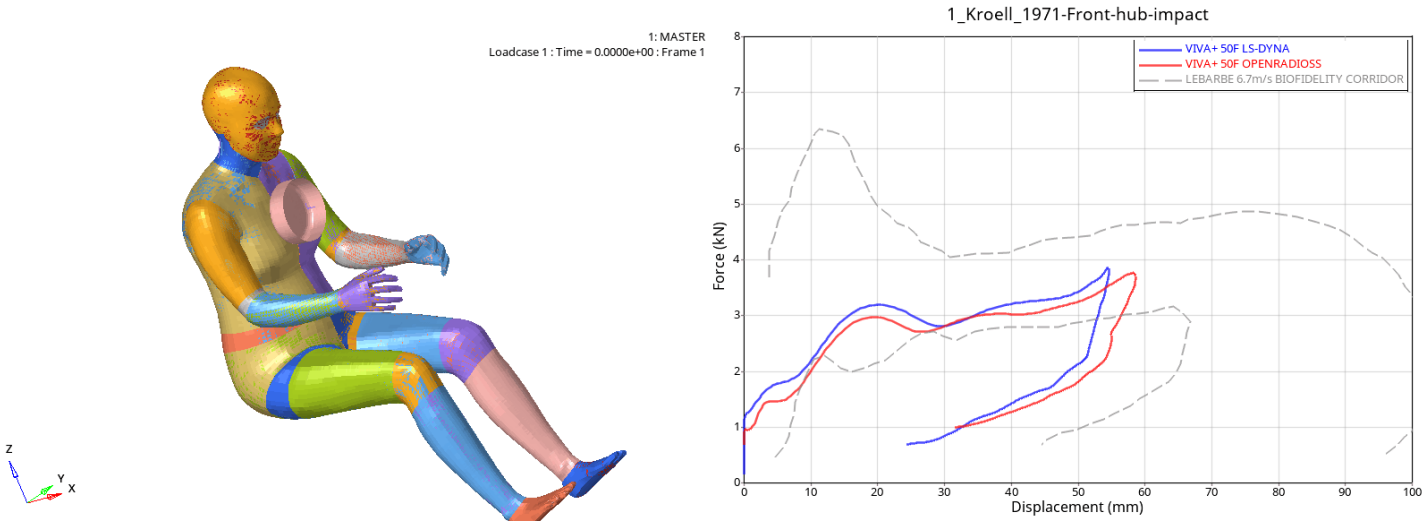
Université de Lyon

Lyon 1

ALTAIR

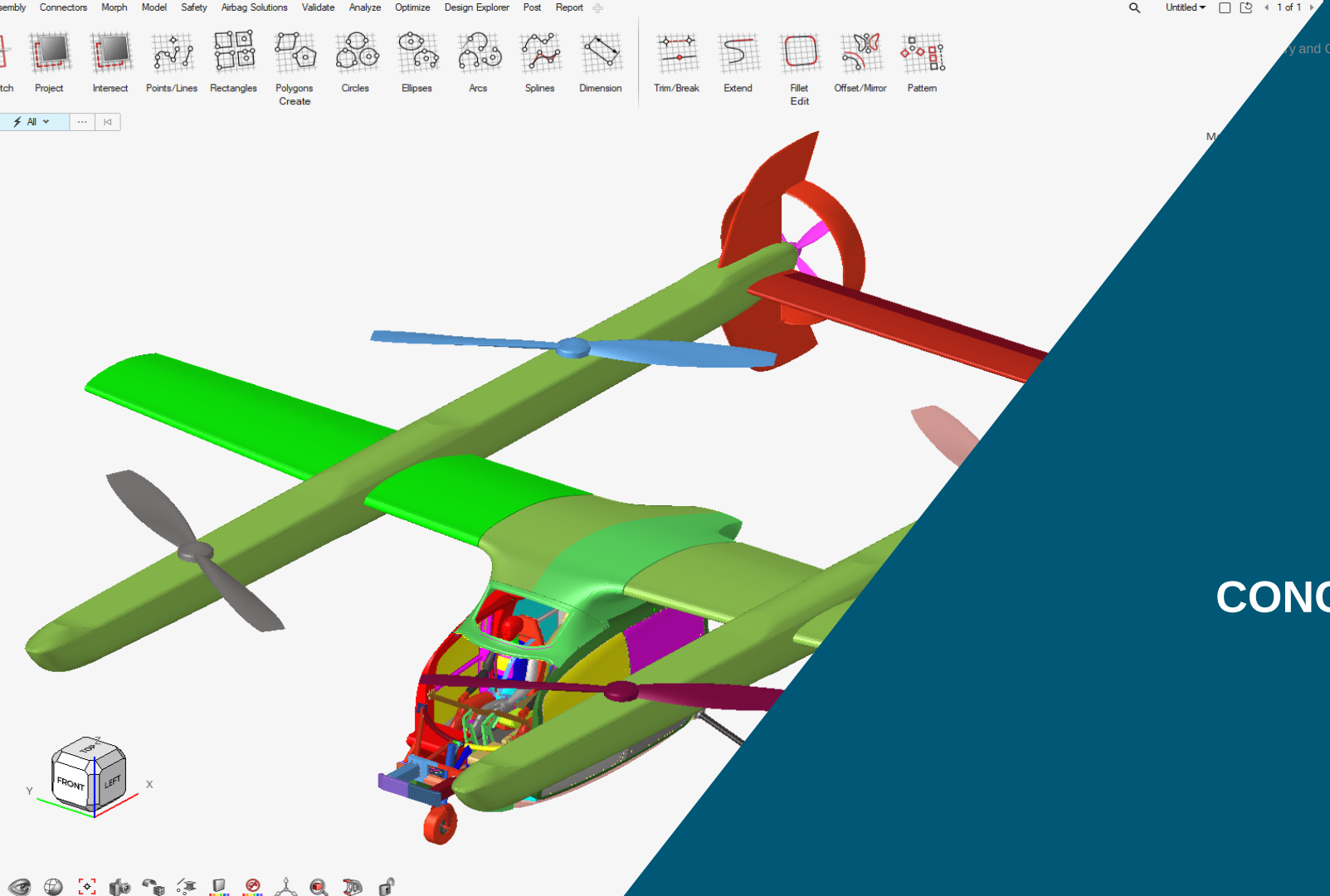
VIVA+ Human Body Model

- Collaboration between Altair and OVTO VIVA+
- From the v1.1.0 release, VIVA+ LS-DYNA input models are compatible with **OpenRadioss** and **Altair Radioss v2024**
- Running the HBM with Radioss is as simple as including it in your Dyna format model
- It can also be included in Radioss ‘block format’ models (‘/INCLUDE_LS-DYNA’)



Test contribution by Mohd Syazwan Abdul Samad, from OpenRadioss community

ALTAIR



CONCLUSION

ALTAIR

Multidisciplinary Collaborations

- Battery pack modelling
- Lightweight materials, aluminum alloys, composite
- Biomechanics, biomaterials, free human models & safety tools
- Defense
- Advanced numerical methods
- HPC, many-cores CPU scalability, accelerators
- AI/ML, ROM
- DevOps, CI/CD, API, Cloud
- Co-simulation & interoperability with third party software

'I can see the enormous potential, Radioss open-source feature will make easier for people like me to contribute in a way that is fine tuned to the needs of customers and I'll be happy to do that!' **Paul du Bois**

Early adopters are enthusiastic
Many collaboration opportunities between Research and Industry

Since the official announcement, this strong interest is confirmed by the high traffic toward **openradioss.org** and **github.com/OpenRadioss** with new contributors and users joining the community everyday!

ALTAIR

OpenRadioss – Build an Active Community

- 3rd users' event in Philadelphia with 300+ registrations!
- Steering committee to shape the future of the code
- Newsletter published twice a year registration from openradioss.org
- LinkedIn community group
- YouTube community channel

www.youtube.com/@OpenRadiossCommunity

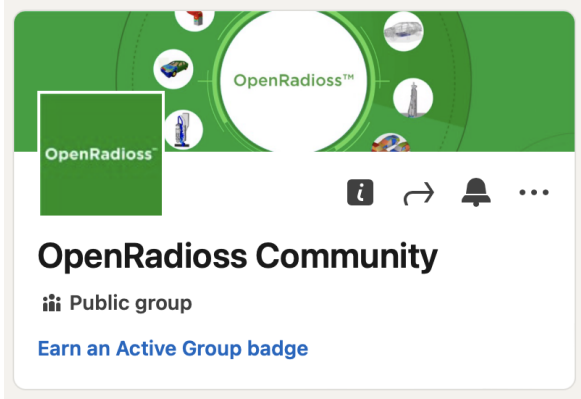
320 subscribers

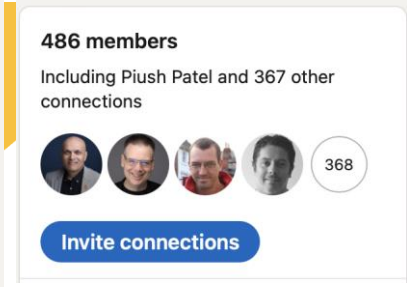
YouTube

10 videos

8,483 views

Joined Aug 30, 2023



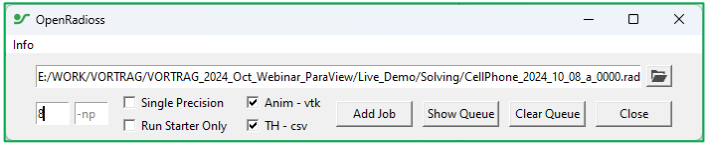


ALTAIR

Live Demo

- *Pre-Processing OpenRadioss model with HyperMesh*
- *Starting OpenRadioss model*
- *Converting animation files to ParaView VTK*
- *Opening OpenRadioss results in **ParaView***

Hand over to François …



CellPhone_2024_10_08_a

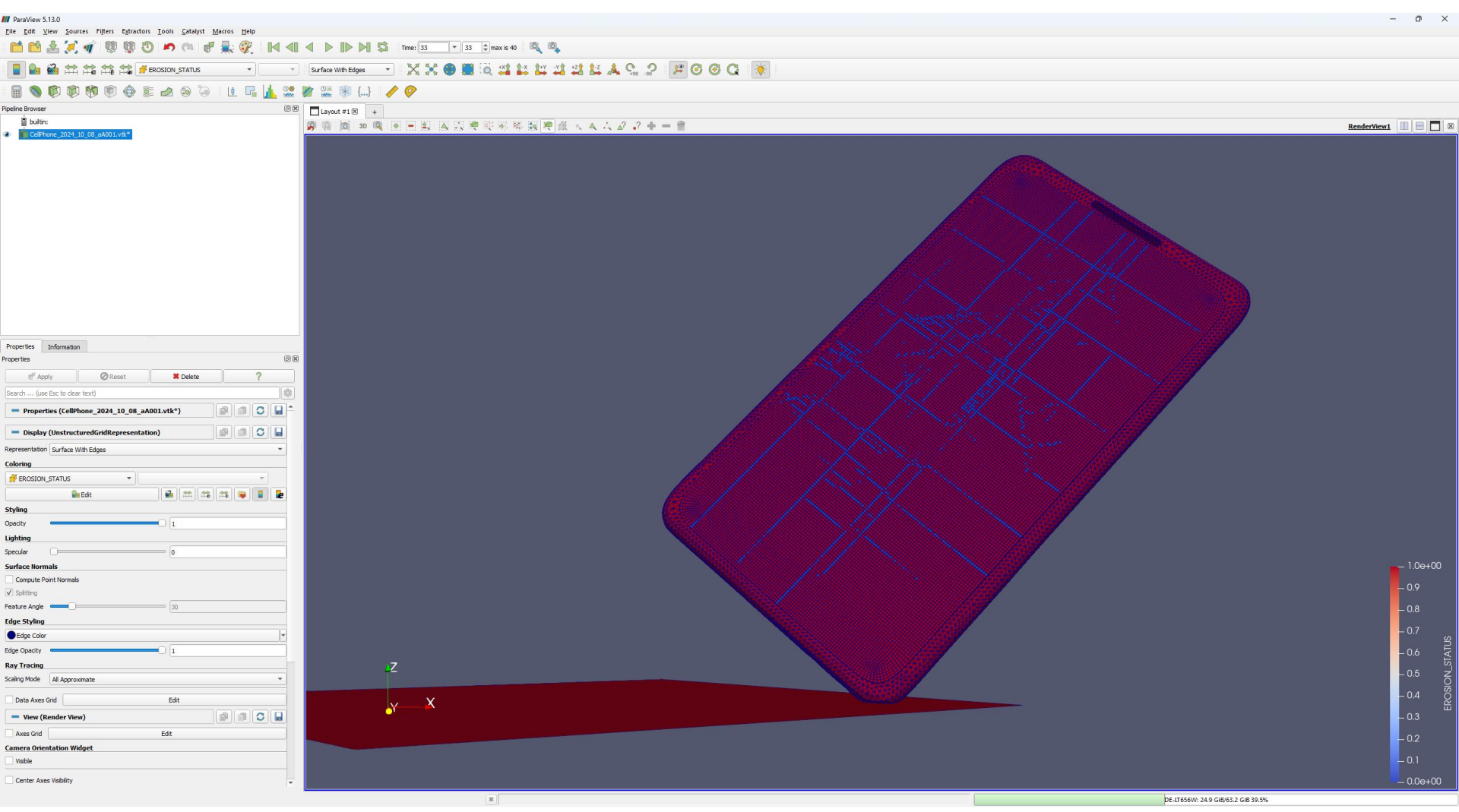
```
**************************************************************************
**                                                                      **
**                                                                      **
**                       OpenRadioss Starter                            **
**                                                                      **
**           Non-linear Finite Element Analysis Software                **
**                                                                      **
**                                                                      **
**                                                                      **
**                 Windows 64 bits, Intel compiler                      **
**                     Double Precision Version                         **
**                                                                      **
**                                                                      **
**                                                                      **
**************************************************************************
** OpenRadioss Software                                                 **
** COPYRIGHT (C) 1986-2024 Altair Engineering, Inc.                     **
** Licensed under GNU Affero General Public License.                    **
** See License file.                                                    **
**************************************************************************

CellPhone Drop Test
 .. UNITS SYSTEM
 .. CONTROL VARIABLES
 .. STARTER RUNNING ON    8 THREADS
 .. FUNCTIONS & TABLES
 .. MATERIALS
 .. NODES
 .. PROPERTIES
 .. 3D SOLID ELEMENTS
 .. 3D SHELL ELEMENTS
 .. SUBSETS
 .. ELEMENT GROUPS
 .. PART GROUPS
 .. SURFACES
 .. NODE GROUP
 .. INITIAL VELOCITIES
 .. DOMAIN DECOMPOSITION
 .. ELEMENT GROUPS
 .. INTERFACES
 .. INTERFACE BUFFER INITIALIZATION
 .. RIGID WALLS
 .. RIGID BODIES
 .. RETURNS TO DOMAIN DECOMPOSITION FOR OPTIMIZATION
 .. DOMAIN DECOMPOSITION
 .. ELEMENT GROUPS
 .. INTERFACES
 .. INTERFACE BUFFER INITIALIZATION
```

CellPhone_2024_10_08_a

```
FAILURE IN SHELL      9041  2ND DIR, LAYER 1 INT POINT 5 AT TIME   1.9915E-03
FAILURE IN SHELL      2310  2ND DIR, LAYER 1 INT POINT 5 AT TIME   1.9930E-03
NC=   28700 T= 1.9935E-03 DT= 6.9459E-08 ERR=-15.6% DM/M= 1.0155E-02
ELAPSED TIME=       1559.40 s  REMAINING TIME=          5.11 s
FAILURE ADVANCEMENT IN SHELL     12621  1ST DIR, LAYER 1 INT POINT 5 AT TIME   1.9938E-03
-- RUPTURE OF SHELL ELEMENT :     34064 AT TIME : 0.1994E-02
-- RUPTURE OF SHELL ELEMENT :      9041 AT TIME : 0.1995E-02
-- RUPTURE OF SHELL ELEMENT :      2310 AT TIME : 0.1996E-02
FAILURE ADVANCEMENT IN SHELL     34457  1ST DIR, LAYER 1 INT POINT 5 AT TIME   1.9996E-03
    RESTART FILES: CellPhone_2024_10_08_a_0001_[0001-0001].rst WRITTEN
    ANIMATION FILE: CellPhone_2024_10_08_aA041 WRITTEN

                        ** CPU USER TIME **


                      ** SUMMARY **

#PROC  CONTSORT  CONTFOR   ELEMENT   KINCOND   INTEG     IO        T0        ASM       RESOL
  1   .1425E+04 .8470E+02 .3058E+04 .4262E+02 .3177E+03 .4656E+03 .9841E+03 .5474E+03 .6381E+04

                  ** CUMULATIVE CPU TIME SUMMARY **

CONTACT SORTING.............: .1425E+04    22.33 %
CONTACT FORCES..............: .8470E+02     1.33 %
ELEMENT FORCES..............: .3058E+04    47.92 %
KINEMATIC COND..............: .4262E+02     0.67 %
INTEGRATION.................: .3177E+03     4.98 %
ASSEMBLING..................: .5474E+03     8.58 %
OTHERS (including I/O)......: .9060E+03    14.20 %
TOTAL.......................: .6381E+04   100.00 %

                  ** MEMORY USAGE STATISTICS **

TOTAL MEMORY USED ..........................:      830 MB
MAXIMUM MEMORY PER PROCESSOR................:      830 MB
MINIMUM MEMORY PER PROCESSOR................:      830 MB
AVERAGE MEMORY PER PROCESSOR................:      830 MB

                  ** DISK USAGE STATISTICS **

TOTAL DISK SPACE USED ......................:       1442 MB
ANIMATION/H3D/TH/OUTP SIZE .................:       1092 MB
RESTART FILE SIZE ..........................:        350 MB

ELAPSED TIME     =       1566.38 s
                         0:26:06

   NORMAL TERMINATION
   TOTAL NUMBER OF CYCLES :   28796


-------------------------------------------------------
Anim-vtk option selected, Converting Anim Files to vtk
-------------------------------------------------------

Anim File Being Converted is CellPhone_2024_10_08_aA001
Anim File Being Converted is CellPhone_2024_10_08_aA002
Anim File Being Converted is CellPhone_2024_10_08_aA003
Anim File Being Converted is CellPhone_2024_10_08_aA004
Anim File Being Converted is CellPhone_2024_10_08_aA005
```

Stop | Kill | Anim | h3d | Close

```
Anim File Being Converted is CellPhone_2024_10_08_aA004
Anim File Being Converted is CellPhone_2024_10_08_aA005
Anim File Being Converted is CellPhone_2024_10_08_aA006
Anim File Being Converted is CellPhone_2024_10_08_aA007
Anim File Being Converted is CellPhone_2024_10_08_aA008
Anim File Being Converted is CellPhone_2024_10_08_aA009
Anim File Being Converted is CellPhone_2024_10_08_aA010
Anim File Being Converted is CellPhone_2024_10_08_aA011
Anim File Being Converted is CellPhone_2024_10_08_aA012
Anim File Being Converted is CellPhone_2024_10_08_aA013
Anim File Being Converted is CellPhone_2024_10_08_aA014
Anim File Being Converted is CellPhone_2024_10_08_aA015
Anim File Being Converted is CellPhone_2024_10_08_aA016
Anim File Being Converted is CellPhone_2024_10_08_aA017
Anim File Being Converted is CellPhone_2024_10_08_aA018
Anim File Being Converted is CellPhone_2024_10_08_aA019
Anim File Being Converted is CellPhone_2024_10_08_aA020
Anim File Being Converted is CellPhone_2024_10_08_aA021
Anim File Being Converted is CellPhone_2024_10_08_aA022
Anim File Being Converted is CellPhone_2024_10_08_aA023
Anim File Being Converted is CellPhone_2024_10_08_aA024
Anim File Being Converted is CellPhone_2024_10_08_aA025
Anim File Being Converted is CellPhone_2024_10_08_aA026
Anim File Being Converted is CellPhone_2024_10_08_aA027
Anim File Being Converted is CellPhone_2024_10_08_aA028
Anim File Being Converted is CellPhone_2024_10_08_aA029
Anim File Being Converted is CellPhone_2024_10_08_aA030
Anim File Being Converted is CellPhone_2024_10_08_aA031
Anim File Being Converted is CellPhone_2024_10_08_aA032
Anim File Being Converted is CellPhone_2024_10_08_aA033
Anim File Being Converted is CellPhone_2024_10_08_aA034
Anim File Being Converted is CellPhone_2024_10_08_aA035
Anim File Being Converted is CellPhone_2024_10_08_aA036
Anim File Being Converted is CellPhone_2024_10_08_aA037
Anim File Being Converted is CellPhone_2024_10_08_aA038
Anim File Being Converted is CellPhone_2024_10_08_aA039
Anim File Being Converted is CellPhone_2024_10_08_aA040
Anim File Being Converted is CellPhone_2024_10_08_aA041

-----------------------------------
Anim file conversion to vtk complete
-----------------------------------


---------------------------------------------------
TH-csv option selected, Converting TH Files to csv
---------------------------------------------------

TH File Being Converted is CellPhone_2024_10_08_aT01

 T01 TO CSV CONVERTER

FILE    = CellPhone_2024_10_08_aT01
OUTPUT FILE    = CellPhone_2024_10_08_aT01.csv
 ** CONVERSION COMPLETED

-----------------------------------
TH file conversion to csv complete
-----------------------------------
```


ParaView 5.13.0
File Edit View Sources Filters Extractors Tools Catalyst Macros Help
Time: 33 33 max is 40
EROSION_STATUS
Surface With Edges
Pipeline Browser
builtin:
CellPhone_2024_10_08_aA001.vtk*
Properties Information
Properties
Apply Reset Delete
Search ... (use Esc to clear text)
Properties (CellPhone_2024_10_08_aA001.vtk*)
Display (UnstructuredGridRepresentation)
Representation Surface With Edges
Coloring
EROSION_STATUS
Edit
Styling
Opacity 1
Lighting
Specular 0
Surface Normals
Compute Point Normals
Splitting
Feature Angle 30
Edge Styling
Edge Color
Edge Opacity 1
Ray Tracing
Scaling Mode All Approximate
Data Axes Grid Edit
View (Render View)
Axes Grid Edit
Camera Orientation Widget
Visible
Center Axes Visibility
Layout #1
RenderView1
Z
Y
X
1.0e+00
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0e+00
EROSION_STATUS
DE-LT656W: 24.9 GiB/63.2 GiB 39.5%

ParaView 5.13.0

File Edit View Sources Filters Extractors Tools Catalyst Macros Help

Pipeline Browser

builtin:

CellPhone_2024_10_08_aA001.vtk*

CellPhone_2024_10_08_aT01.csv

Properties Information

Properties

Apply Reset Delete ?

Search ... (use Esc to clear text)

Properties (CellPhone_2024_10_08_aT01.csv)

Detect Numeric Columns

Use String Delimiter

Have Headers

Field Delimiter Characters ,

Add Tab Field Delimiter

Merge Consecutive Delimiters

Display (XYChartRepresentation)

Attribute Type Row Data

X Axis Parameters

Use Index For X Axis

X Array Name time

Series Parameters

Variable	
CONTACT ENERGY	
EXTERNAL WORK	
HOURGLASS ENERGY	
INTERNAL ENERGY	
KINETIC ENERGY	
MASS	
ROTATION ENERGY	
SPRING ENERGY	
TH INTER	15 New INTER 15
TH INTER	15 New INTER 15

Layout #1

RenderView1

3.8e+05
350000
300000
250000
200000
150000
100000
50000
0.0e+00
NODE_ID

Z
Y
X

LineChartView1

INTERNAL ENERGY
KINETIC ENERGY

560 540 520 500 480 460 440 420 400 380 360 340 320 300 280 260 240 220 200 180 160 140 120 100 80 60 40 20 0

0 0.0001 0.0002 0.0003 0.0004 0.0005 0.0006 0.0007 0.0008 0.0009 0.001 0.0011 0.0012 0.0013 0.0014 0.0015 0.0016 0.0017 0.0018 0.0019 0.002

DE-LT656W: 24.5 GiB/63.2 GiB 38.8%

THANK YOU

altair.com

#ONLYFORWARD

E-Mail: ***communitymanager***@openradioss.org

ALTAIR