

# Implementation of calculation methods on a digital engineering platform

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openSPDM

BORDEAUX  
INP Enseirb-  
Matmeca

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# Simulation Process Data Management

## \\ Growing number of simulation software

- ✓ Compatibility
- ✓ Large amount of data

## \\ Companies' requirements

- ✓ Fiability
- ✓ Traceability
- ✓ Accessibility
- ✓ Safekeeping



*Credits : Damien Laval, Naval Group 2021,  
Présentation Exemples de Use Cases Naval Group*

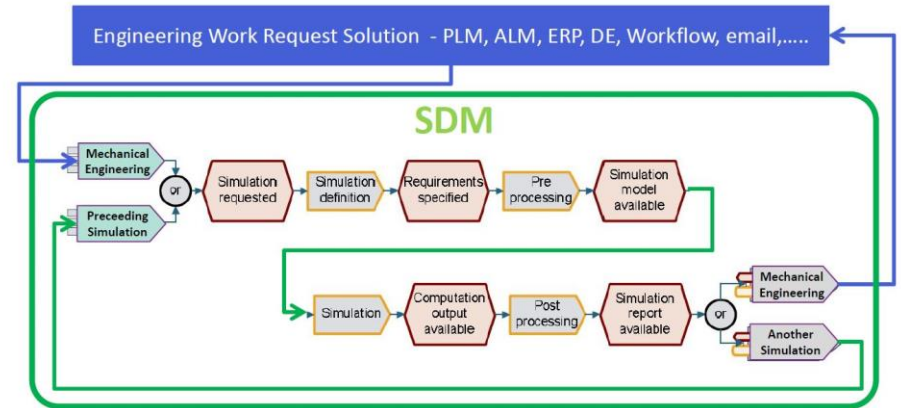
# Simulation Process Data Management

## \\ Framework establishment

- ✓ Multiple actors
- ✓ Secured data

## \\ Standard Data Model

- ✓ Established with Airbus and BMW
- ✓ Standard at the end of the 90s
- ✓ Study represented by core objects



Crédit Image : Edward Mark Norris, 20 years' experience of SPDM best practices, NAFEMS  Enseirb-Matmecca

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# OpenSPDM

## ❖ Open Source SPDM solution

- ✓ Adaptive : standard data model
- ✓ Customisable : Webclient Aras Innovator

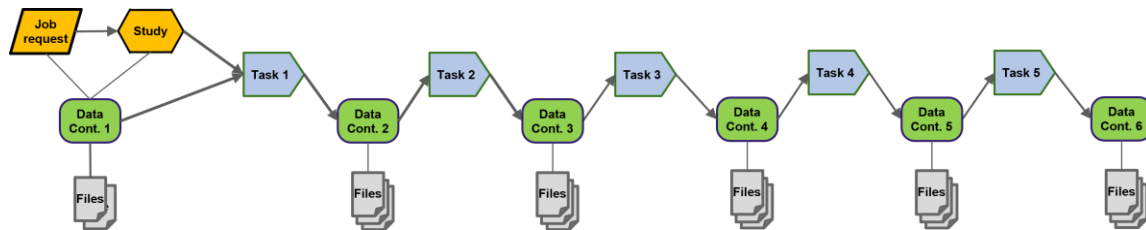
## ❖ Shared core

### ✓ Fundamental objects

- Study
- Task
- Artifact

### ✓ Personalized objects

- Budgets
- BOMs



Crédit Image : Edward Mark Norris, A standardised approach to building CAE application connectors to SPDM solutions, NAFEMS World Congress 2021

# OpenSPDM

## \\ **Webclient Aras Innovator**

- ↓ User interface
- ↓ Databases

## \\ **Local application**

- ↓ Methods and scripts
- ↓ Ressources
- ↓ Connectors



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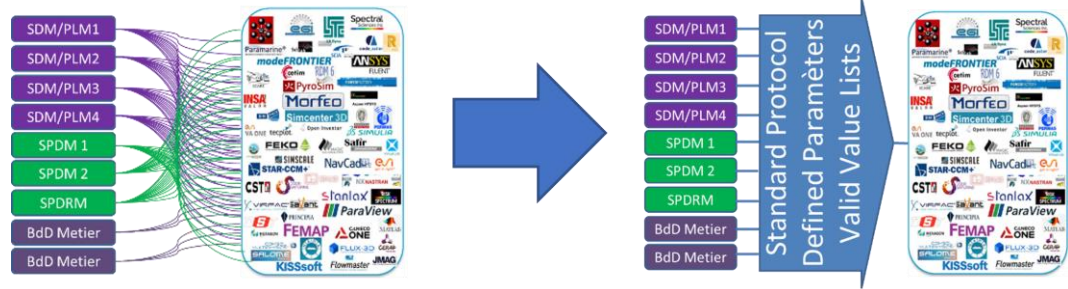
# Generalities

## \\ Interface

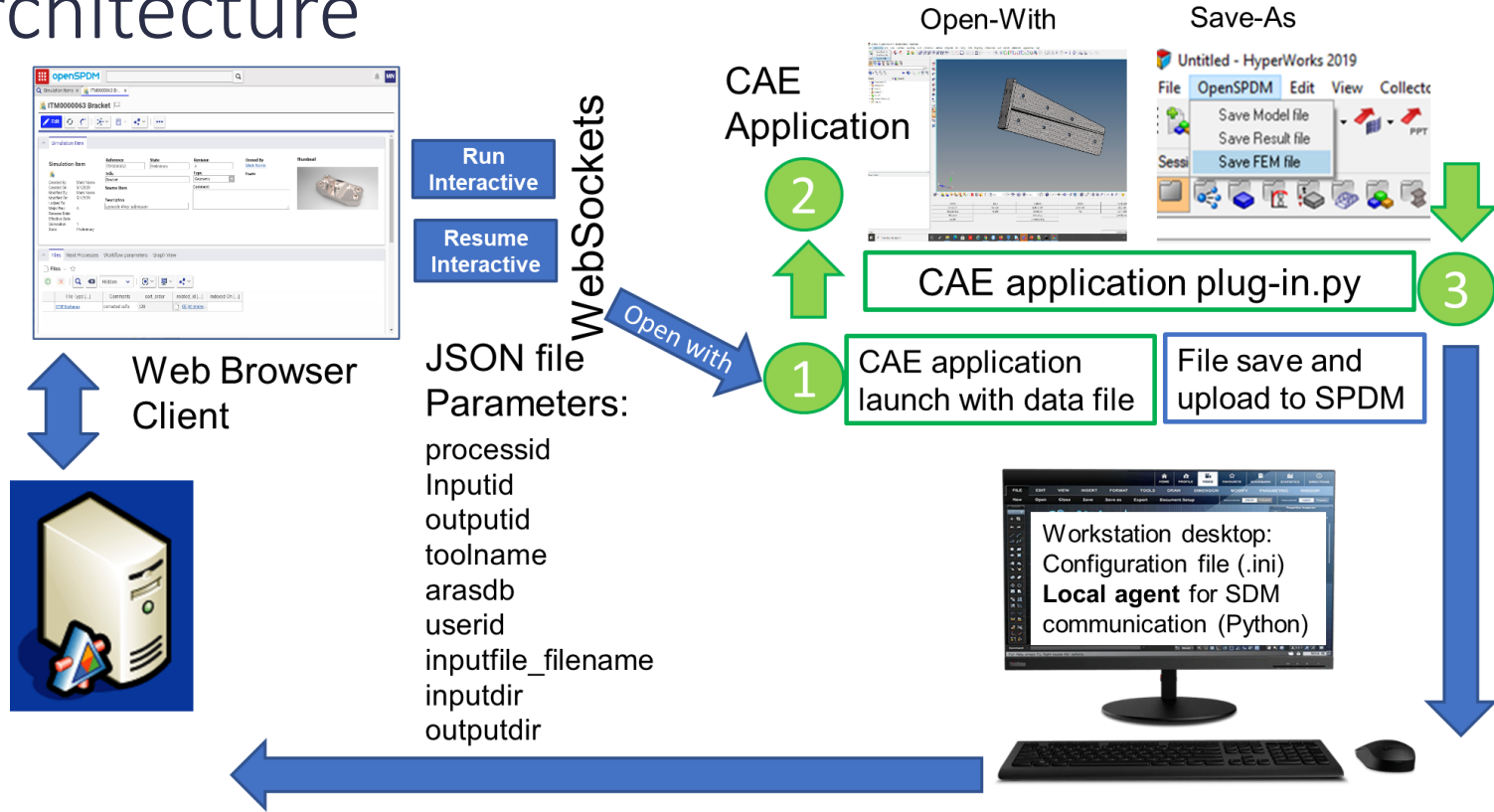
- ✓ SPDM software and simulation software
- ✓ Data communication
- ✓ Bypasses file based storage system

## \\ Framework

- ✓ Standard protocols
- ✓ Defined parameters
- ✓ Valid value lists



# Architecture



Credits : Edward Mark Norris, A standardised approach to building CAE application connectors to SPDM solutions, NAFEMS World Congress 2021

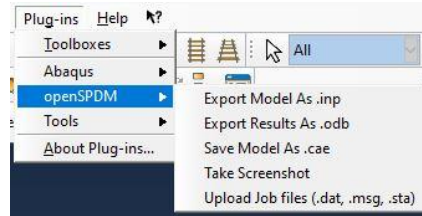
# Abaqus CAE Connector

## ❖ Software integration

- ✓ Plugin

## ❖ Functionalities

- ✓ Export as .inp file
- ✓ Export as .cae file
- ✓ Export results as .odb file
- ✓ Screenshots and animations
- ✓ Export of control files
- ✓ Export of geometry as .stp



```
#-----PLEASE MODIFY HERE-----
author = "yann.sudrat@openspdm.com"
module_name = 'SPDM_kernel'
myversion = "1.0"
description1 = "To Save output database as .odb into SPDM server"
buttonText1 = 'Export Results As .odb'
URL = '-'

ApplicationMods = ("Visualization", )

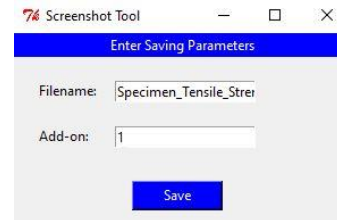
#-----END OF MODIFICATION-----

MENU_ACCESS_PATH = "openSPDM|"

thisPath = os.path.abspath(__file__)
thisDir = os.path.dirname(thisPath)

toolset = getAFXApp().getAFXMainWindow().getPluginToolset()

toolset.registerKernelMenuButton(
    buttonText=MENU_ACCESS_PATH+buttonText1,
    moduleName=module_name,
    functionName="export_odb()",
    applicableModules=ApplicationMods,
    author=author,
    description=description1,
```



# LS-PrePost Connector

## \\ Software integration

- ✓ Macros

## \\ Functionalities

- ✓ Export as .k file
- ✓ Export as .proj file
- ✓ Screenshots

\*Configure\_Toolbar\_Macro.cfg - Bloc-notes

Fichier Edition Format Affichage Aide

TTB Tip

5

TTB MacroDefine Start

\*

\*

\*

TTB MacroDefine End

TTB Icon Path

TTB Title

Personal Macro 1

TTB Tip

6

TTB MacroDefine Start

\*

\*

\*

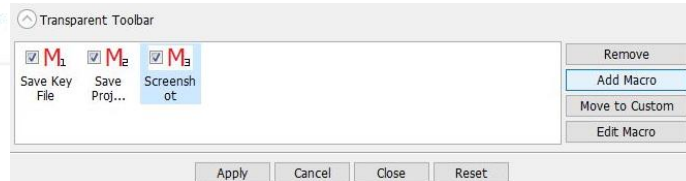
TTB MacroDefine End

TTB Icon Path

TTB Title

OpenSPDM Macro 1

TTB Tip



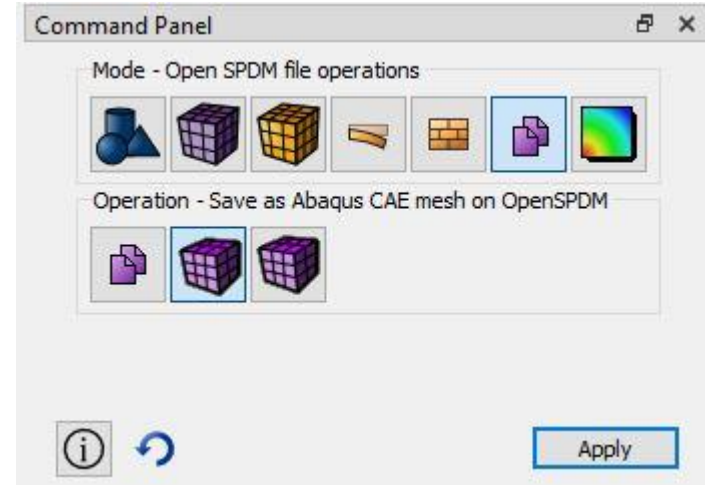
# Coreform Cubit Connector

## \\ Software integration

- ✓ Custom menu

## \\ Functionalities

- ✓ Export as .cub5 file
- ✓ Export meshes
  - .inp extension
  - .k extension



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# Mesh convergence

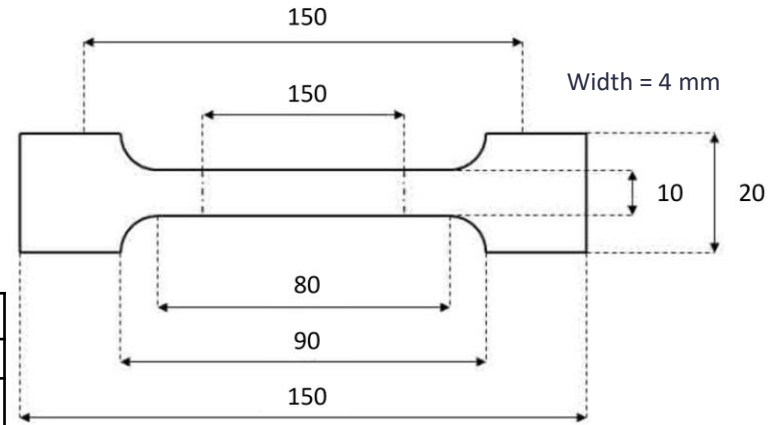
## Geometry

↓ ISO-3167 standard

## Material

↓ Aluminium alloy 7075

Aluminium 7075			
Composition		Mechanical properties	
Aluminium	87.1 – 91.4 %	Density $\rho$ (g.cm <sup>-3</sup> )	3.0
Zinc	5 – 6 %	Young Modulus E (MPa)	71000
Magnesium	2.1 – 2.9 %	Poisson coefficient $\nu$ ( $\varnothing$ )	0.32
Copper	1.2 – 2 %	Johnson Cook coefficients	
Other components	0 – 0.5 %	A (MPa)	546
		B (MPa)	678
		C	0.024
		n ( $\varnothing$ )	0.71
		m ( $\varnothing$ )	1.56

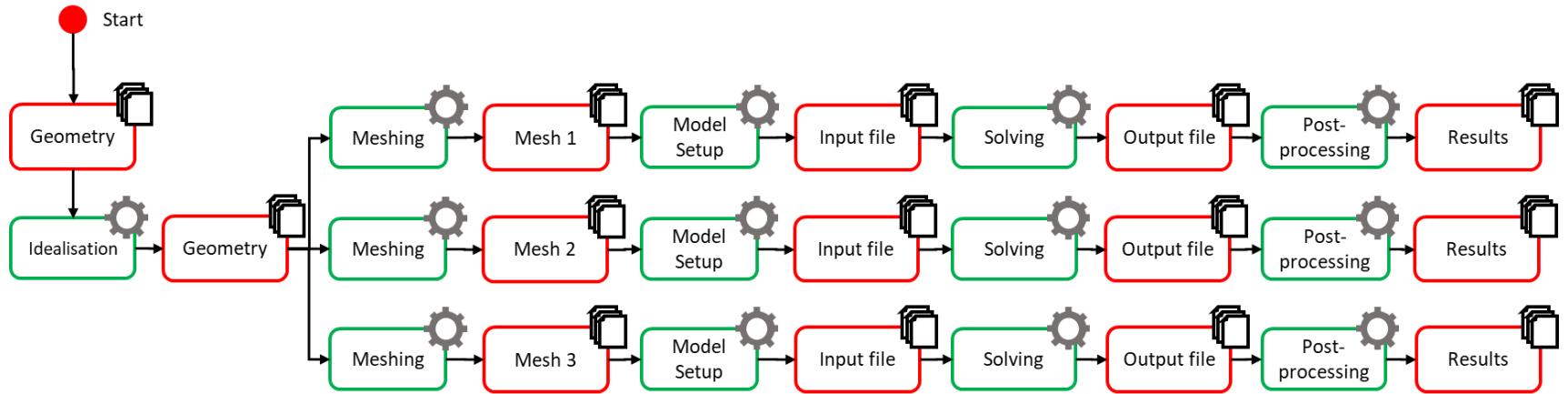


All values are in mm



# Mesh convergence

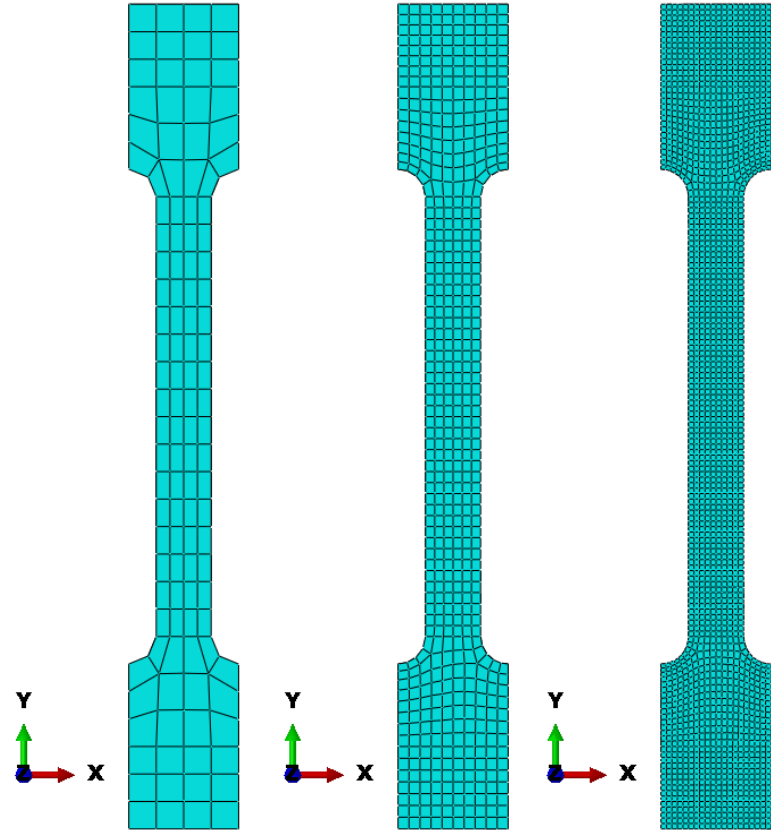
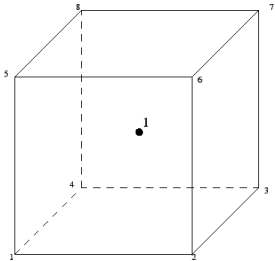
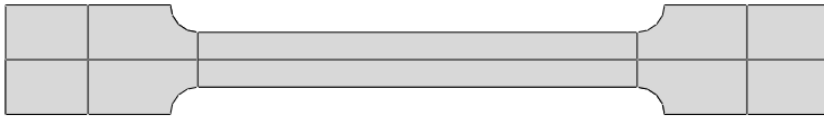
## Study graph



# Mesh convergence

## Mesh

- ✓ Continuum shell elements SC8R
- ✓ 3 mesh sizes : 1mm, 2mm, 5mm
- ✓ Partitioning



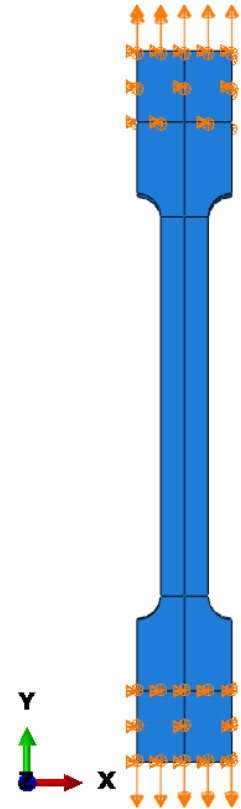
# Mesh convergence

## \\ Load case

- ✓ X and Z translations locked
- ✓ Imposed displacement of 10mm on both ends

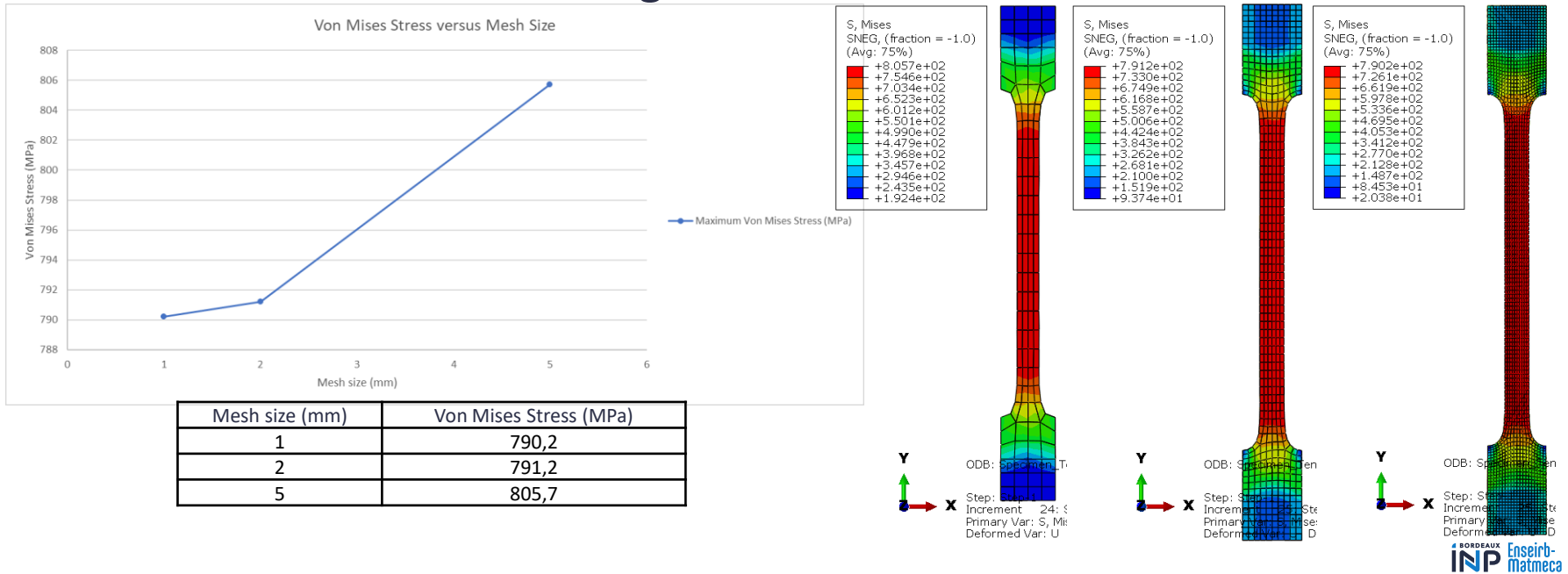
## \\ Static step

- ✓ Traction considered slow enough to be quasi-static



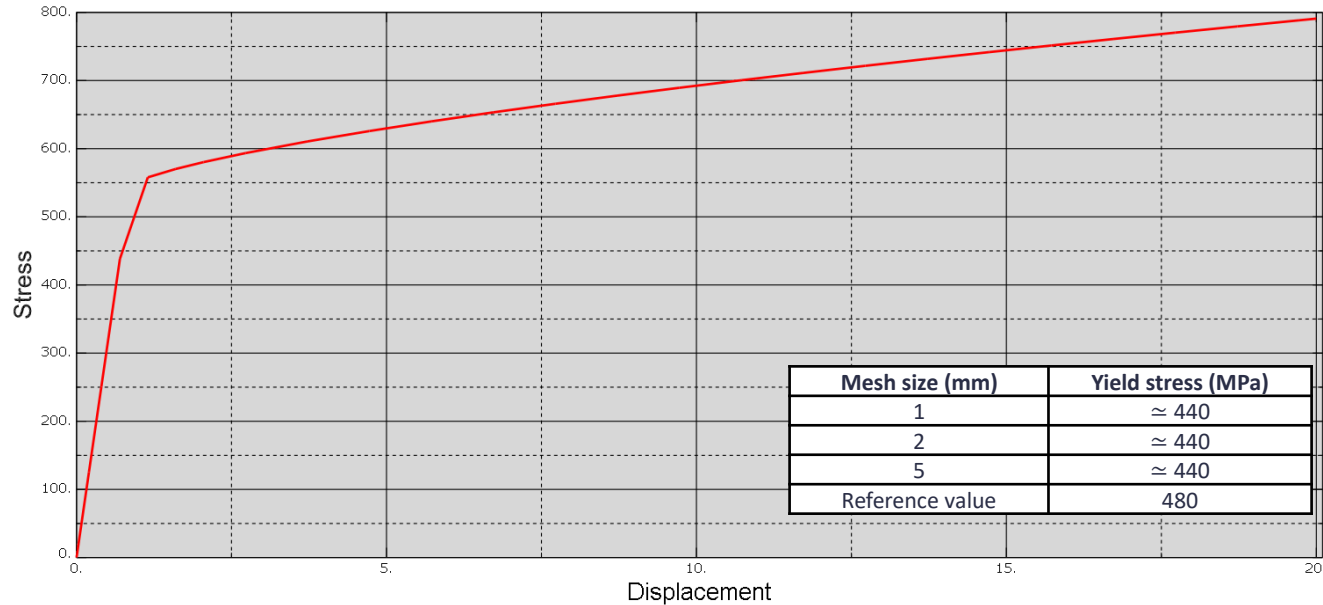
# Mesh convergence

## Von Mises Stress convergence



# Mesh convergence

## Stress displacement graph





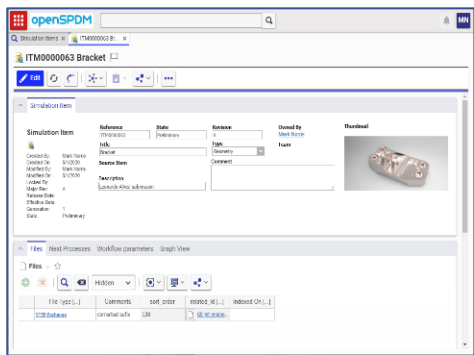
MINISTÈRE  
DE L'ENSEIGNEMENT  
SUPÉRIEUR,  
DE LA RECHERCHE  
ET DE L'INNOVATION

*Liberté  
Égalité  
Fraternité*



Thank you for your attention





Client Web



Run Interactive

Resume Interactive

WebSockets

Paramètres

- Outil
- Numéros ID
- Données entrée
- Données sortie
- Auteur
- ...

Outil CAD

2

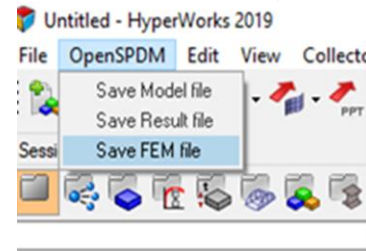
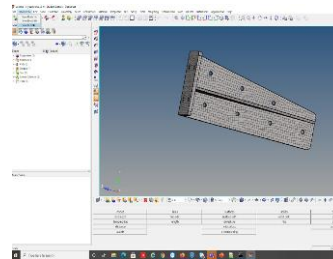


1

Exécute

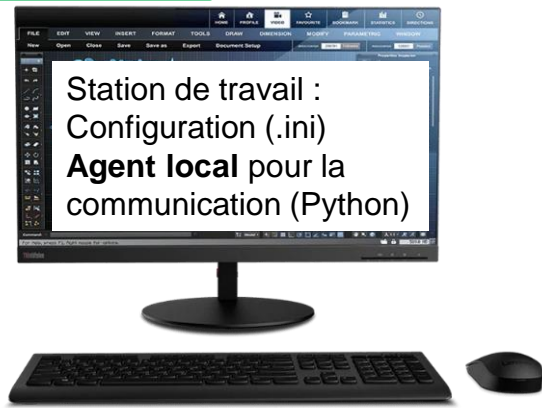
Lancement de l'outil avec les données d'entrée

Sauvegarde fichier et téléversement



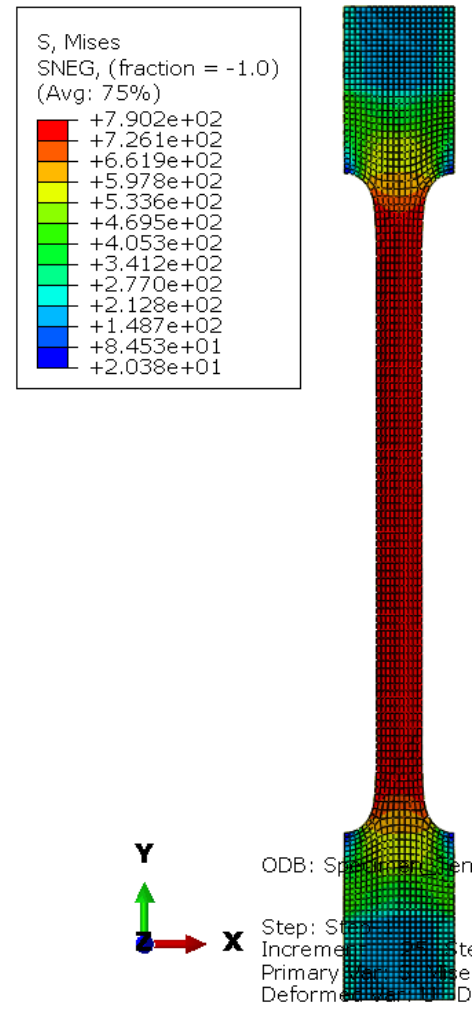
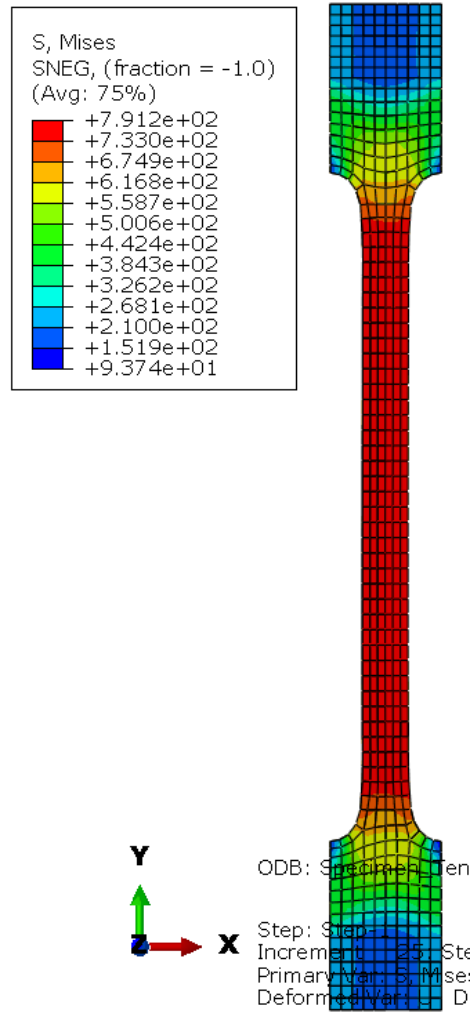
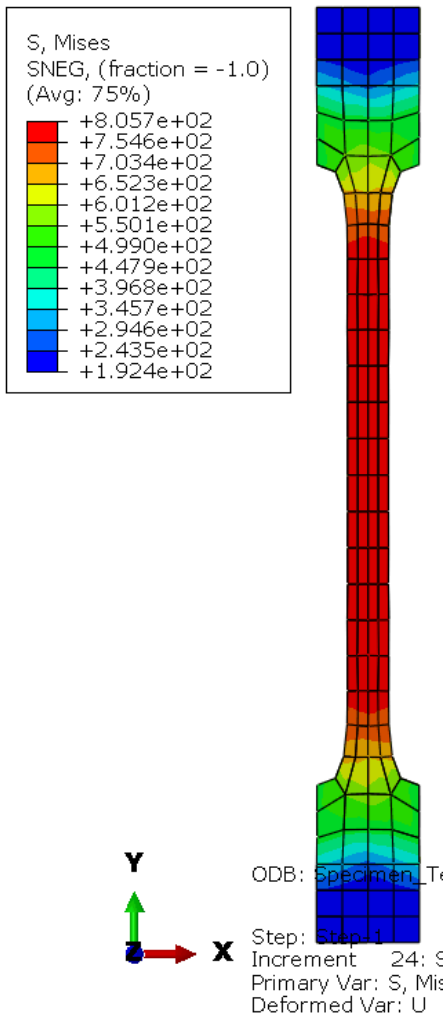
Application CAD plug-in.py

3



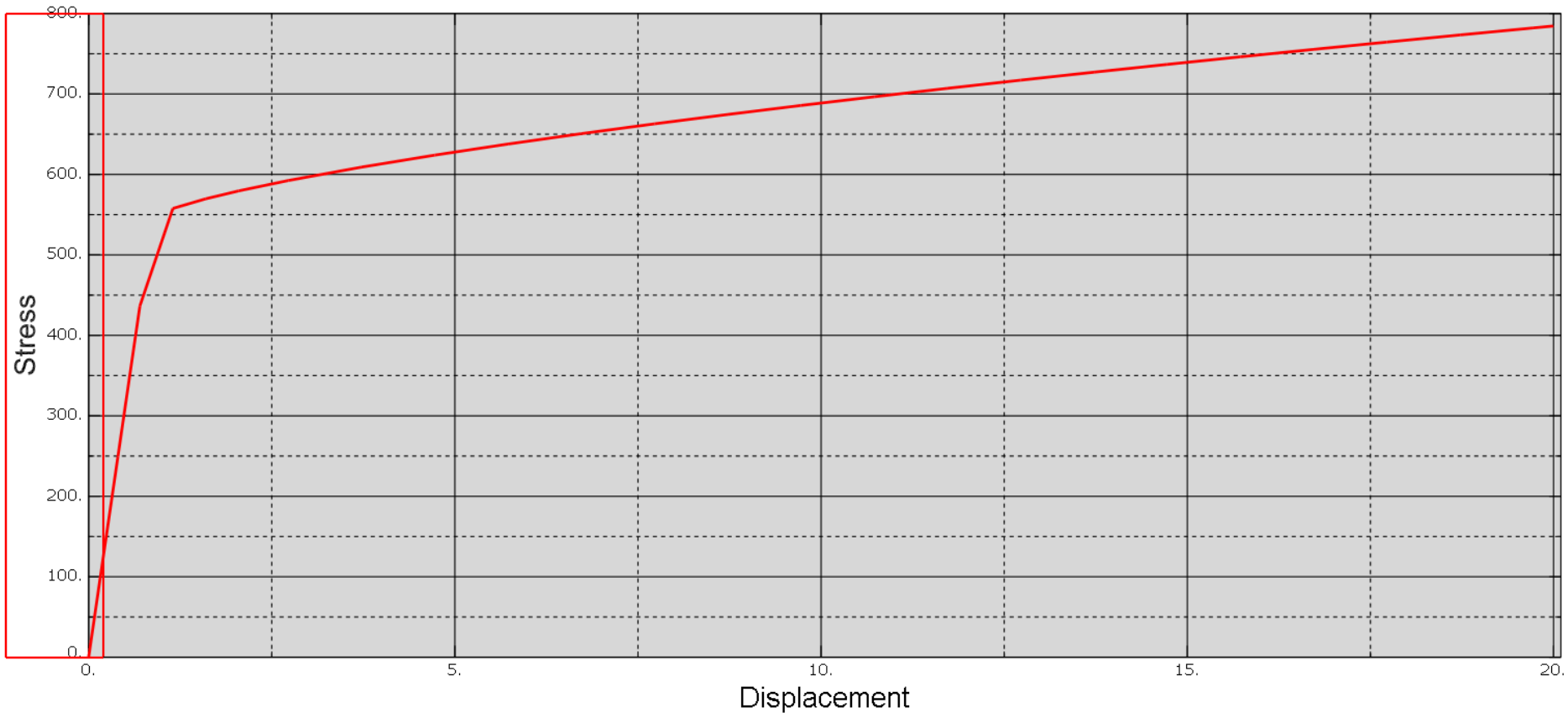
Application Serveur





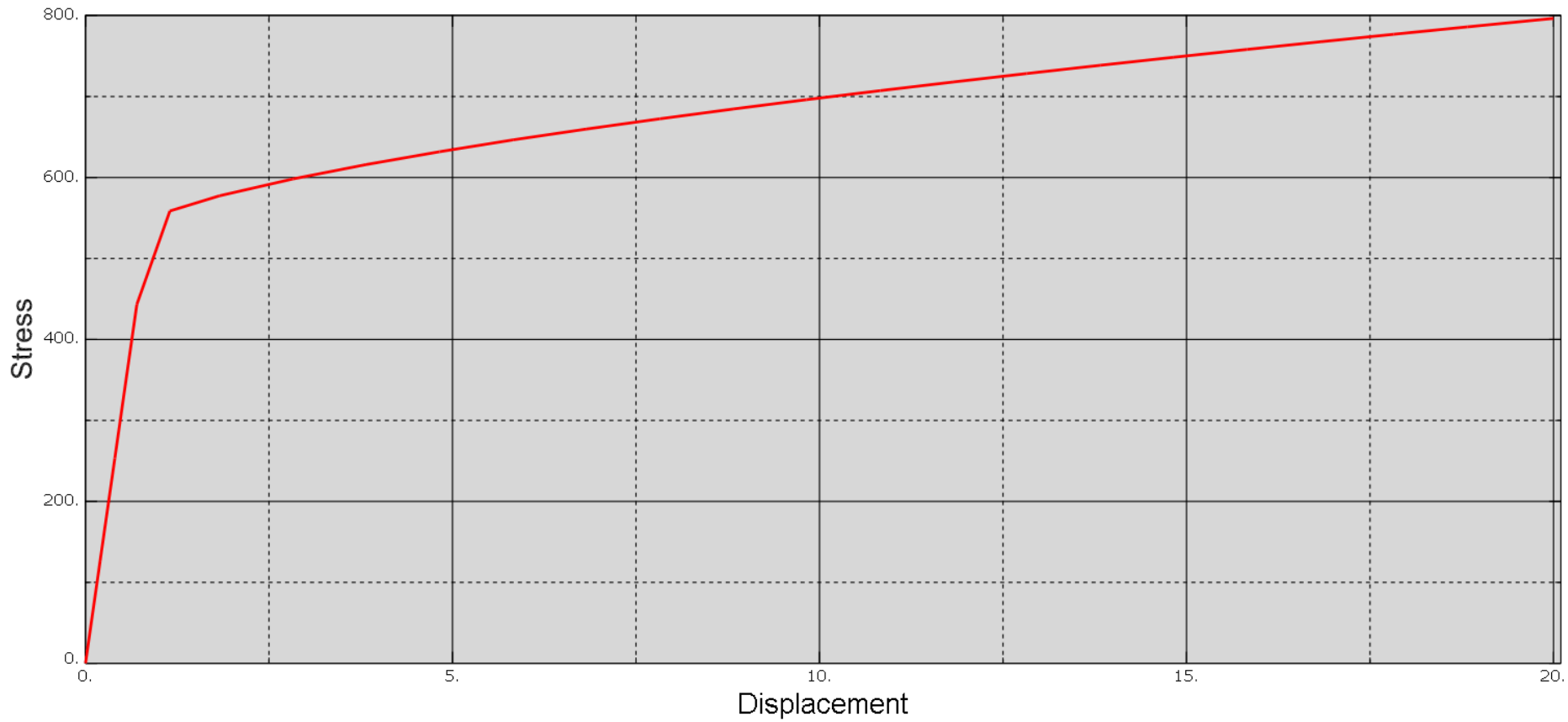


Réponse contrainte déplacement, maillage 5mm



— \_temp\_9

Réponse contrainte déplacement, maillage 5mm



XYData-1