VMAP
Standards Community e.V.

MpCCI Tools for VMAP

Presence and outlook

www.vmap-standard.org

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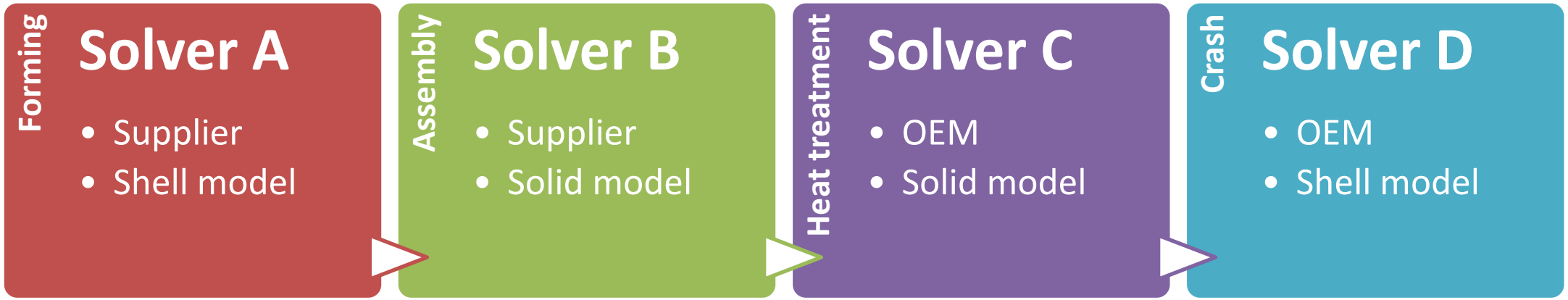
Overview

- MpCCI Mapper – VMAP in Manufacturing Processes
- MpCCI FSIMapper – VMAP in Fluid-Structure-Interaction
- MpCCI Nexum – VMAP link to ontology

MpCCI Mapper

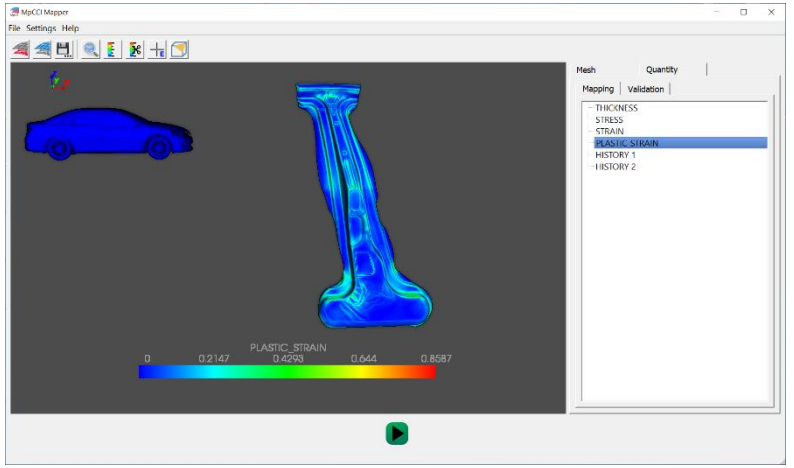
- Simulation of product manufacturing processes and resulting product performance

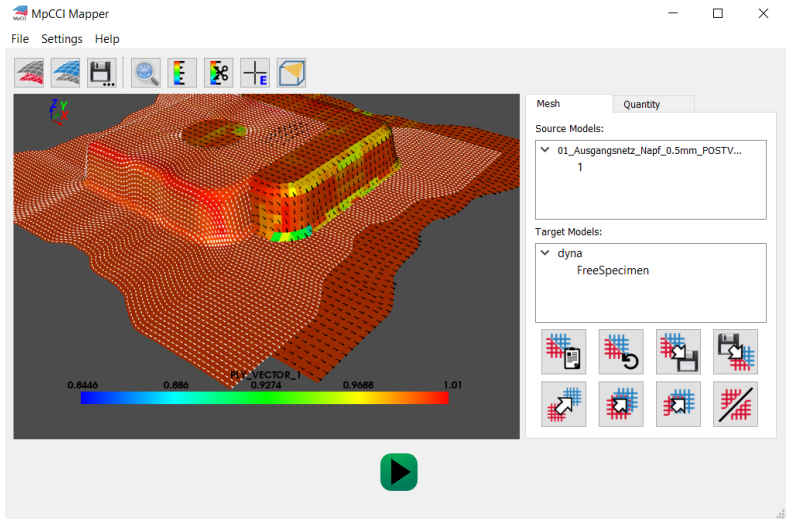
- Mechanical properties shall be transferred as initial conditions to subsequent manufacturing simulation steps



MpCCI Mapper

- Supports vast number of native CAE result formats and optical measurement data
- Automatic and interactive mesh positioning when
- Robust and efficient algorithms for mapping of various element types and quantities
- Validation of mapping accuracy
- Batch capability





MpCCI Mapper

Metal Forming
LS-Dyna, PAMStamp, AutoForm, Forge, Simufact Forming, Abaqus, COPRA FEA, RADIOSS, **VMAP**

Welding
Simufact Welding, ANSYS Mechanical, Abaqus, **VMAP**

Molding
Moldflow, Cadmould, Moldex3D, B-Sim, **VMAP**

Composites
LS-Dyna, Abaqus, PAMCrash, VTK, **VMAP**

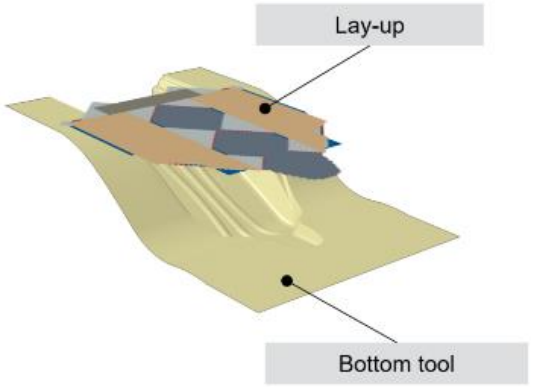
Crash / Structural
LS-Dyna, PAMCrash, Abaqus, Nastran, RADIOSS, OptiStruct, ANSYS Mechanical, **VMAP**

Measurement
Atos, Argus, Aramis, Autogrid, STL, Ply, **VMAP**

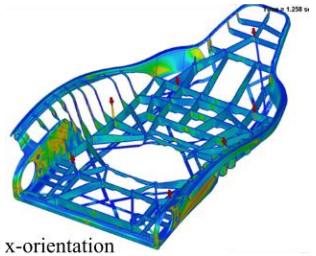
MpCCI Mapper

Hybrid Injection Molding Process

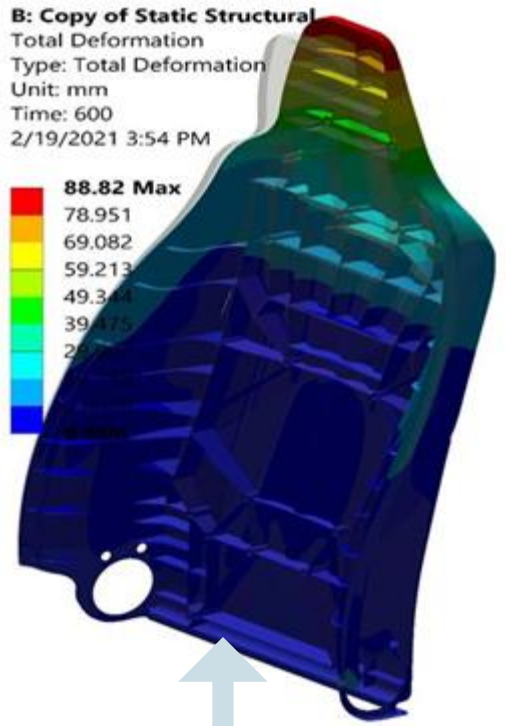
UD Laminate draping



Injection molding



Load test



MpCCI FSIMapper

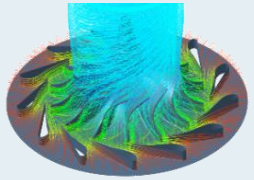
- Weak coupled fluid-structure interactions (FSI) where the interaction between a fluid and a solid structure is relatively weak

- Normally, the deformation of the structure does not significantly affect the flow of the fluid

➢ Fluid and structure can be modeled independently of each other

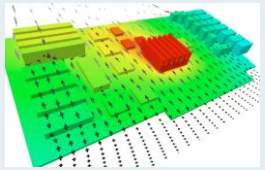
➢ Coupling between the fluid and the solid is realized by one-way transfer of boundary conditions

MpCCI FSIMapper



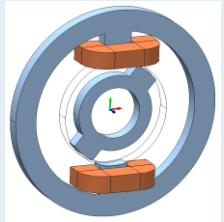
Fluid

Fluent, CFX, Star-CCM+, FINE/Turbo, OpenFOAM, EnSight Case, **VMAP**



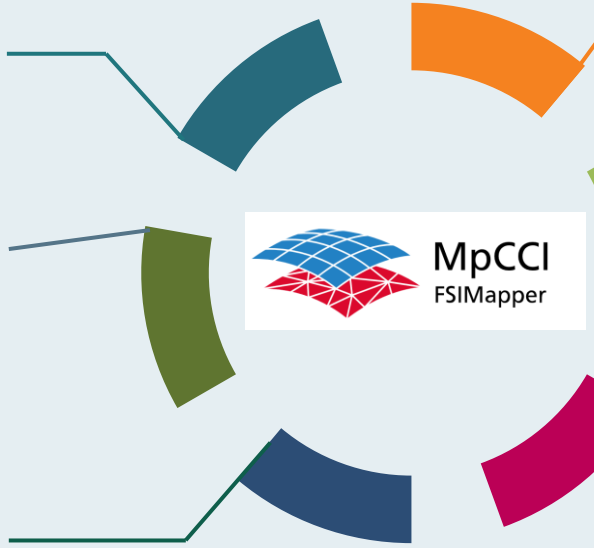
Electronics

FloTHERM, FloTHERM XT, FloEFD, Celsius (6SigmaET) , **VMAP**



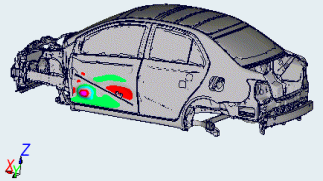
EM

JMAG, MagNet, Maxwell, EnSight Case, **VMAP**



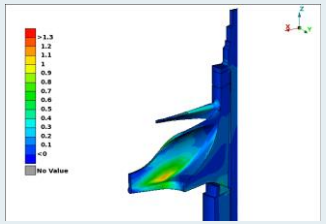
NVH

Abaqus, ANSYS Mechanical, LS-Dyna, Nastran Bulk, **VMAP**



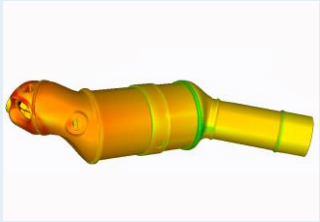
Structural / Deformation

Abaqus, ANSYS Mechanical, LS-Dyna, Nastran Bulk, **VMAP**



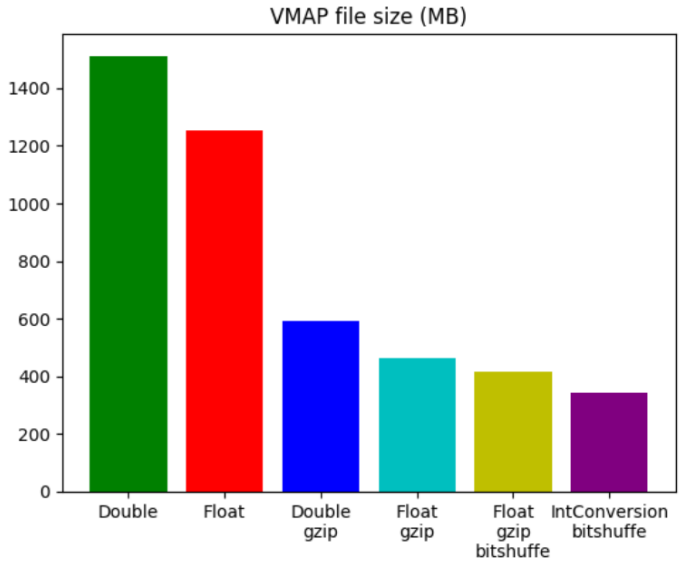
Thermal Stress / Heat transfer

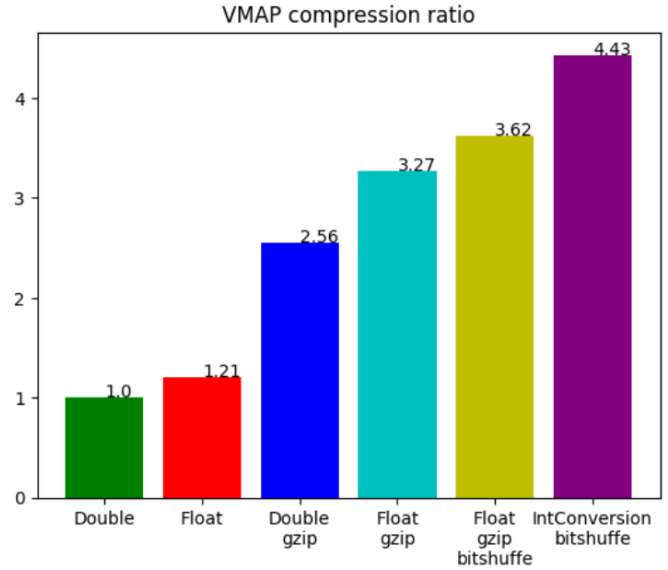
Abaqus, ANSYS Mechanical, LS-Dyna, Nastran Bulk, **VMAP**



MpCCI FSIMapper

- Transient temperature, pressure or force data
- Enhanced CFD geometries
  - Polygons
  - Polyhedrons
- Compression
  - Floating point precision
  - Gzip vs bitshuffle filter
  - Float to integer conversion
  - FEMZip

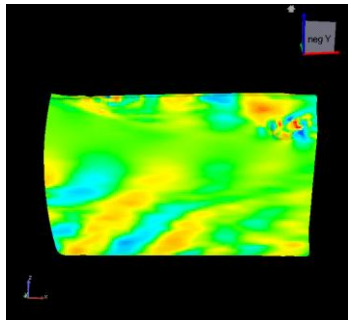




MpCCI FSIMapper

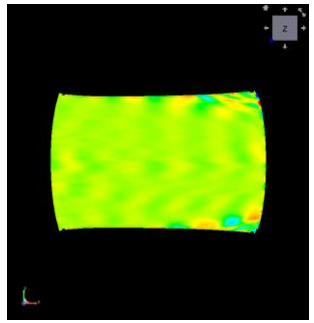
- Aerodynamic loads for NVH analysis
- Transient CFD analysis of vehicle
- Pressure field is mapped
- Fourier Transformation is applied to steady state
- Resulting frequency dependent loading can be integrated in vibration analysis

Door



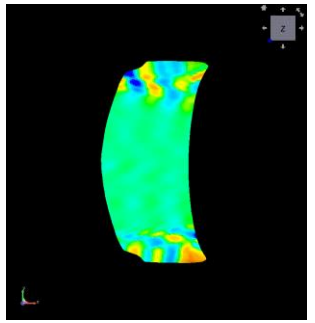
Sound insulation

Roof



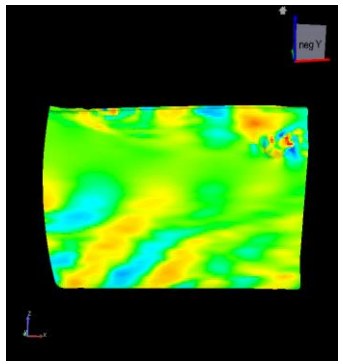
Structure and sound insulation

Hood

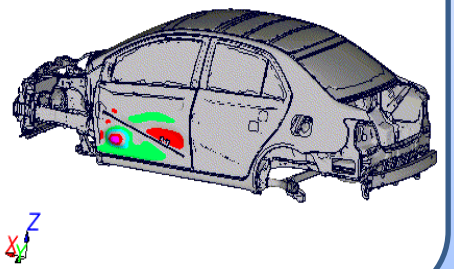


Hood flatter

Aerodynamic excitation

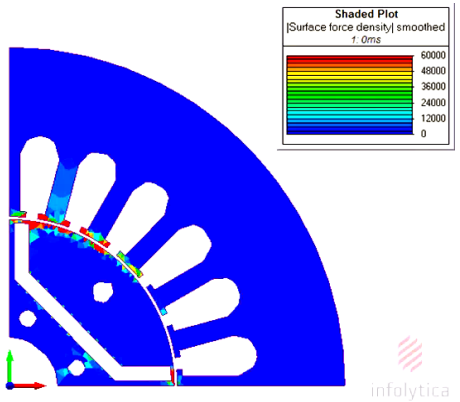


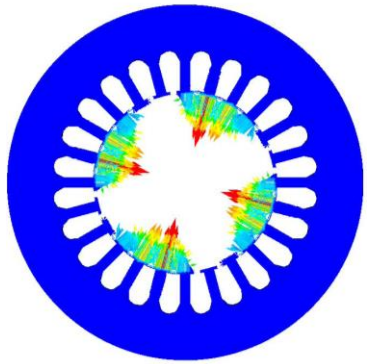
Nastran frequency response



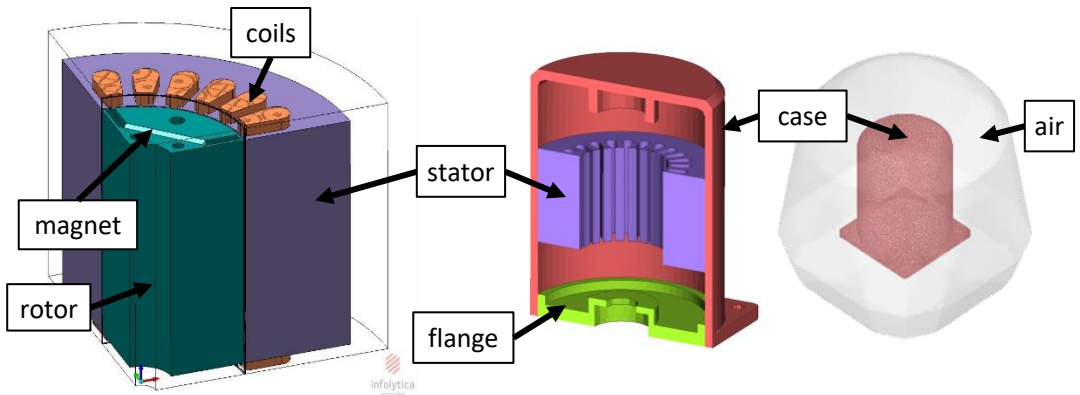
MpCCI FSIMapper

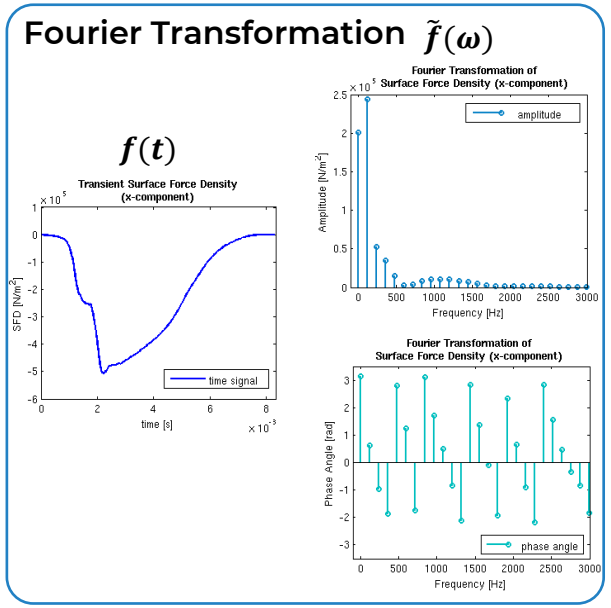
- Motor with a 24-slots stator and a 4-poles rotor (with interior permanent magnets)
- Periodic quarter model
- Transient analysis of one quarter turn
- Constant time steps
- Fourier Transformation of mapped transient forces

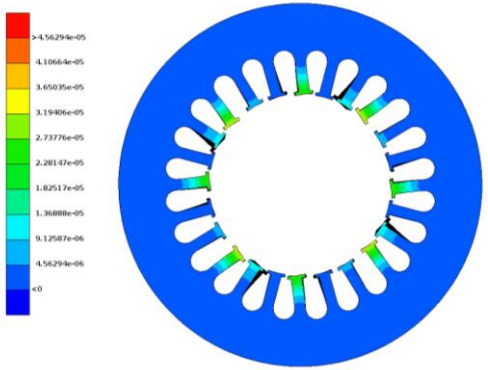




Surface Force Density [N/mm²] extended to the full target model



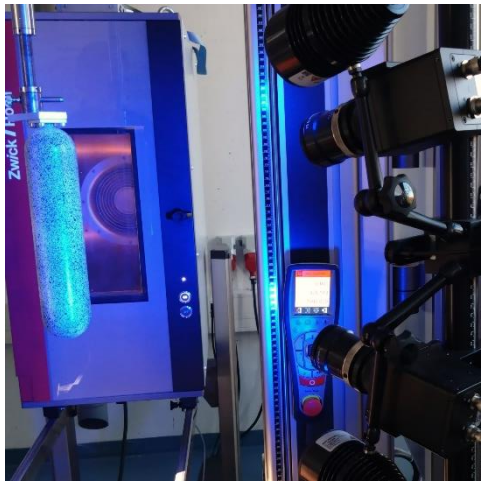




Displacement at 120 Hz (scaled by 5.e4)

MpCCI Nexum

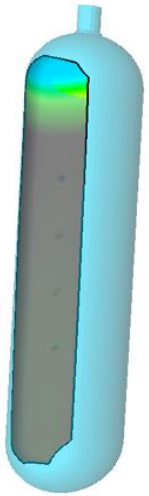
Measurement



Results

Setup

Uncertainties



Connecting both worlds

VMAP

Simulation

Elements

Parts

Variables

MpCCI Nexum

- Semantic annotation of VMAP files by creating metadata in JSON format to link with ontology concepts

- Benefits:
  - Enhance interoperability and improve data discoverability
  - Facilitates machine understanding of VMAP data
  - Enables advanced querying and reasoning capabilities over the data
  - Supports better data analysis and visualization

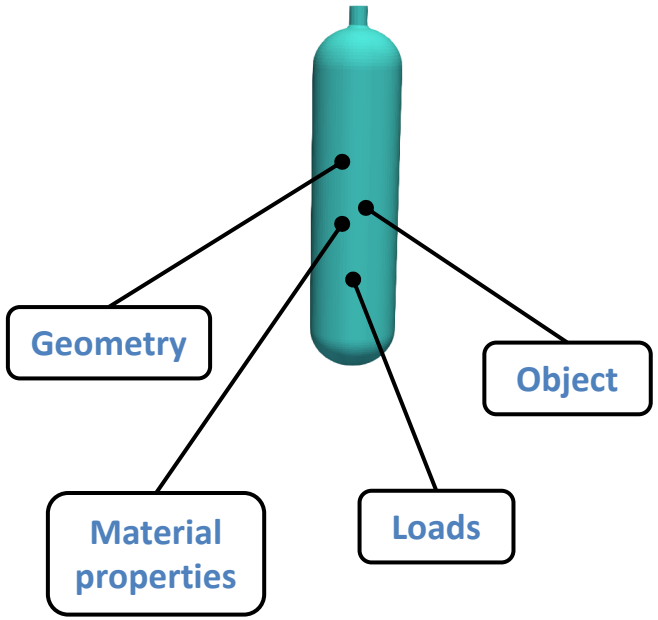
MpCCI Nexum

How to store **parameters** from simulation or measurement trials ?

Common approach:

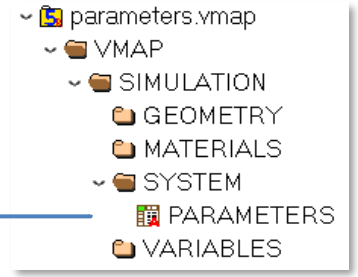
found in file name

- pipe_PR04_YM1350_TEMP90.vmap
- pipe_PR04_YM1400_TEMP90.vmap
- pipe_PR04_YM1500_TEMP90.vmap
- pipe_PR04_YM1500_TEMP95.vmap
- pipe_PR04_YM1500_TEMP98.vmap
- pipe_PR04_YM1500_TEMP99.vmap
- pipe_PR036_YM150_TEMP80.vmap
- pipe_PR036_YM1400_TEMP80.vmap
- pipe_PR036_YM1450_TEMP80.vmap
- pipe_PR036_YM1500_TEMP80.vmap
- pipe_PR036_YM1500_TEMP82.vmap
- pipe_PR036_YM1500_TEMP85.vmap
- pipe_PR036_YM1500_TEMP90.vmap
- pipe_PR038_YM1500_TEMP90.vmap



New VMAP approach:

stored in additional dataset



	0		
	myName	myValue	myDescription
0	POISSONS-RATIO	0.4	
1	TEMPERATURE-LOAD	90.0	
2	YOUNGS-MODULUS	1500.0	

MpCCI Nexum

```
File Name:
    o example_01.vmap
VMAP:
    Simulation:
    Measurement:
        User Defined Parameter Names:
            o POISSONS-RATIO
            o TEMPERATURE-LOAD
            o YOUNGS-MODULUS
        Associated Parameter Values:
            o 0.4
            o 90
            o 1500
        VMAP Specific State Variables:
            o TEMP
            o DISPLACEMENT
        User Defined State Variables:
            o STRAIN-X
            o STRAIN-Y
        User Defined Devices:
            o Stereoscopic Measuring System
            o Thermocouple Measuring System
        Number of Devices:
            o 2
        User Defined Element Types:
            o STL
        Number of Coordinate Systems:
            o 2
        SI Units:
            o mm
            o kg
            o s
            o A
            o C
            o mol
            o cd
```

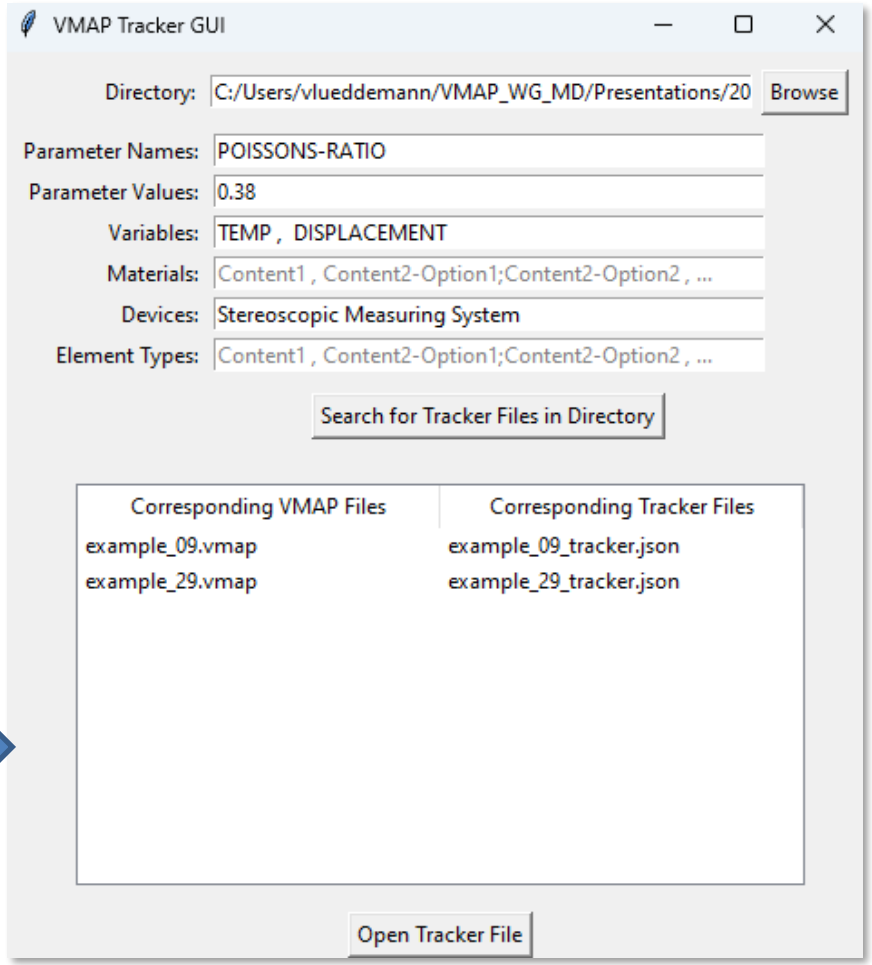
VMAP files contain a **variety of data**

example_01.vmap 61.556 KB

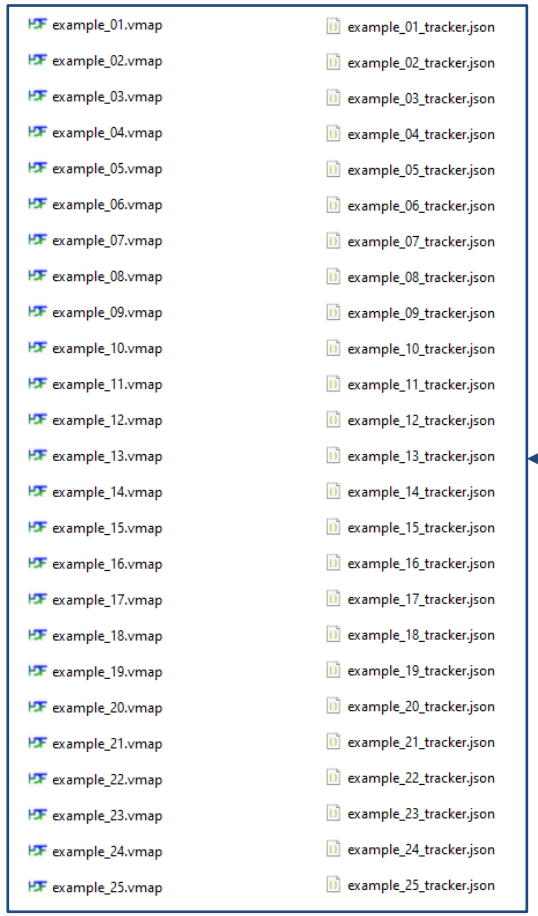
Tracker files store key information

example_01_tracker.json 3 KB

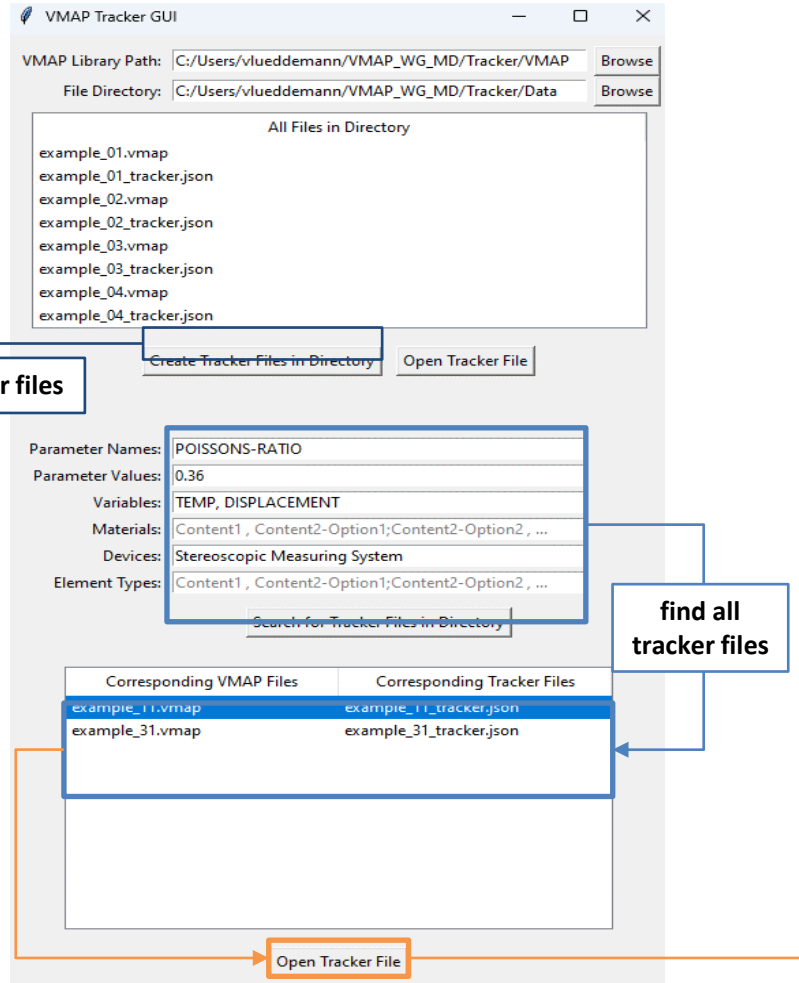
Use tracker files to **search** for certain VMAP files



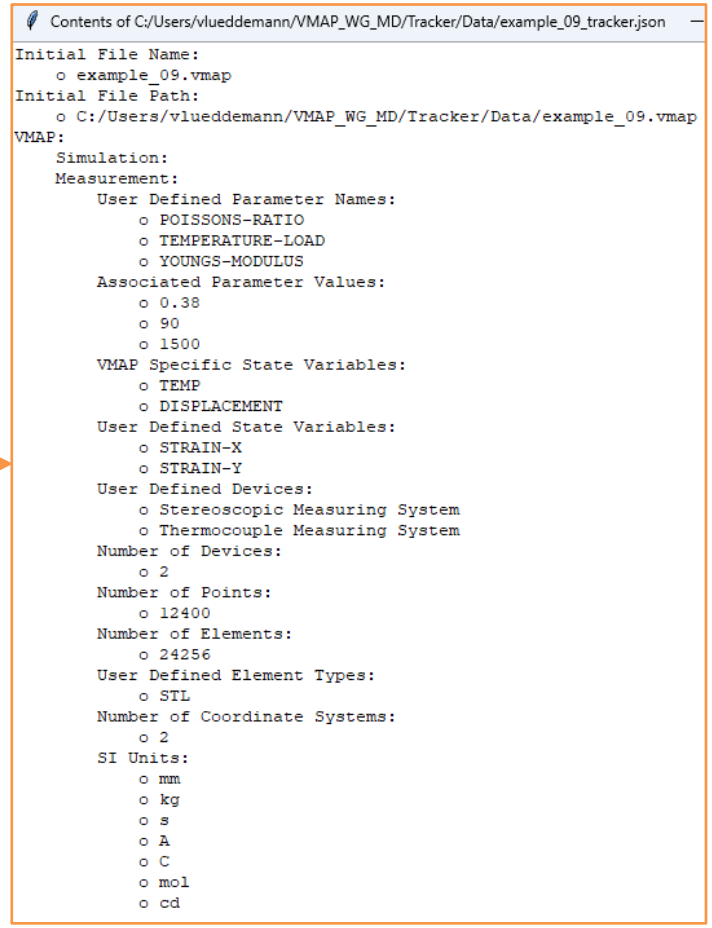
MpCCI Nexum



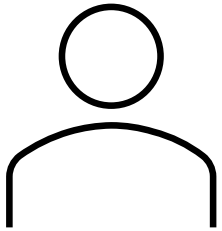
create tracker files



find all tracker files



Contact Us



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