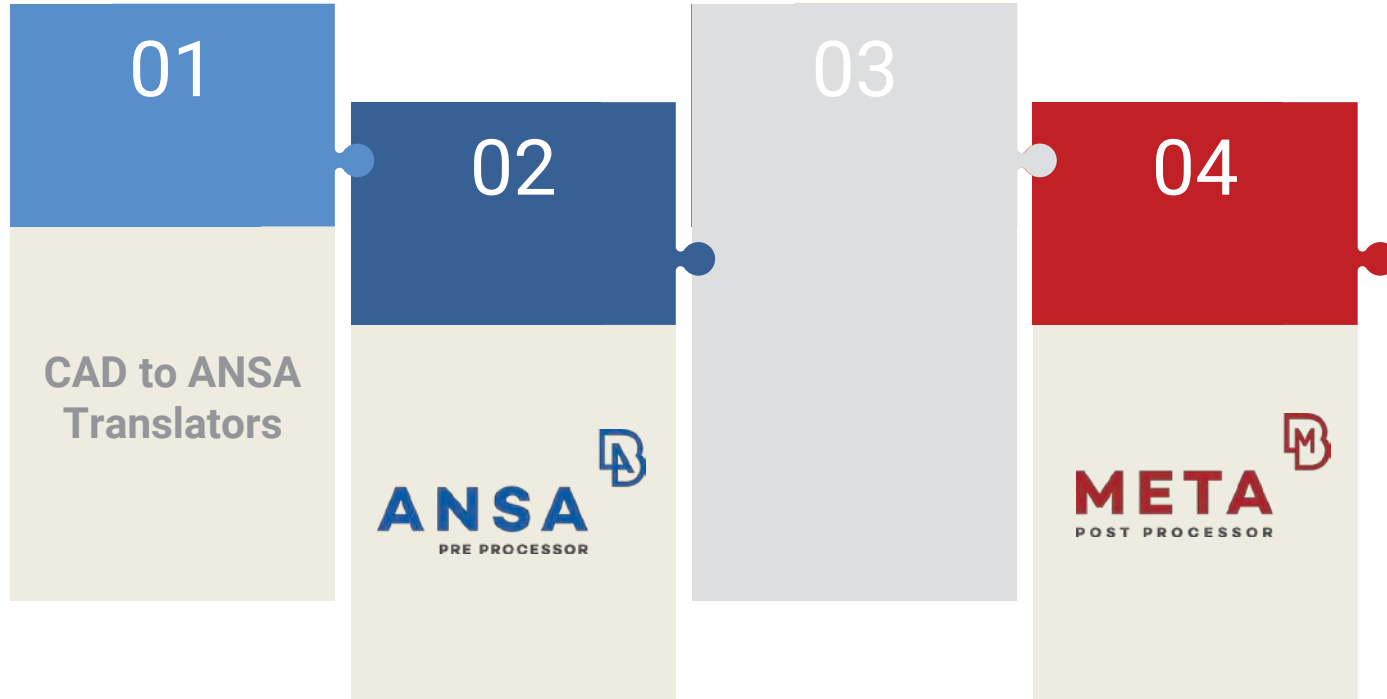


**3D MESH GENERATION IN ANSA
FOR METAL CASTING SIMULATION WITH PROCAST :
AN AUTOMATED PROCESS FOR BREMBO**

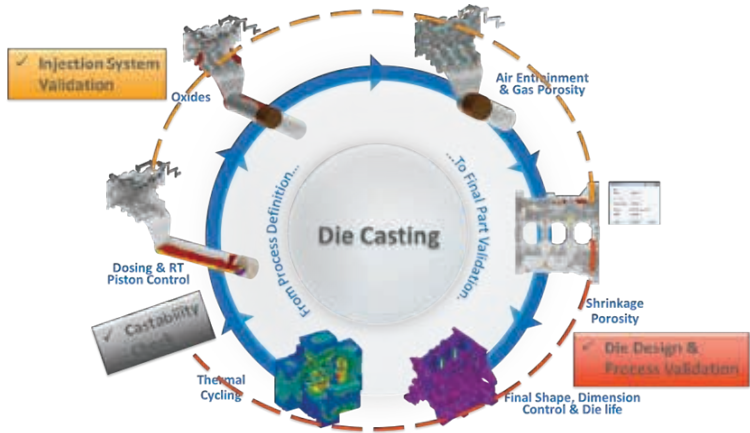
Metal casting analysis workflow





ProCAST

Supporting entire Casting Process Chain



- ✓ Predict in advance
- ✓ Deliver on time
- ✓ Control costs and improve profitability

Virtual Assurance
 against unforeseen
 Try-out and
 Production Costs



Topics of this presentation:

ANSA – ProCAST – META solution

1. Pre-processing challenges
2. Why ANSA
3. Post-processing with META

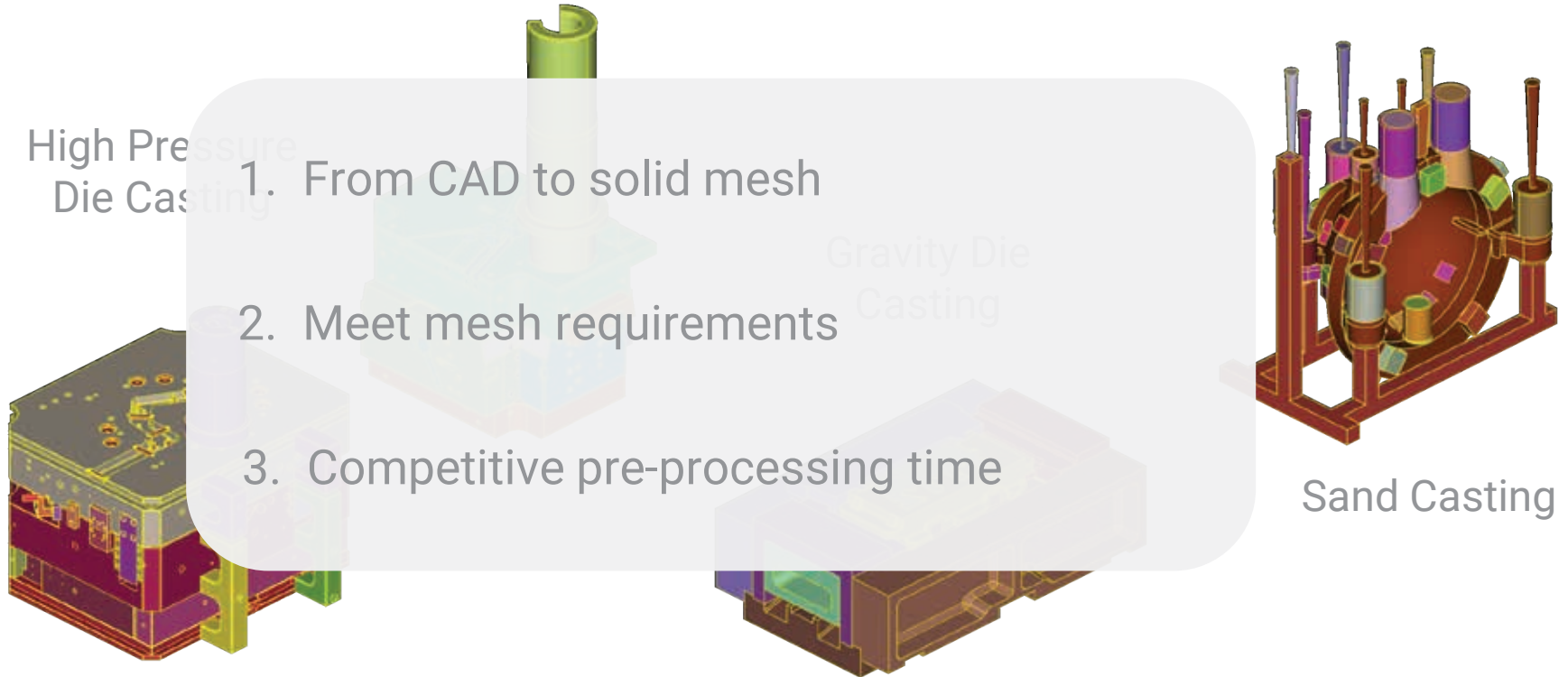
BREMBO: Automated mesh for ProCAST

1. Process Key Features
2. Automatic update of the model geometry (according to user inputs)
3. Automatic recognition of the casted volumes
4. Automatic mesh generation (according to user inputs)
5. Current status, Benefits and stats, Further improvements

ANSA – ProCAST – META solution

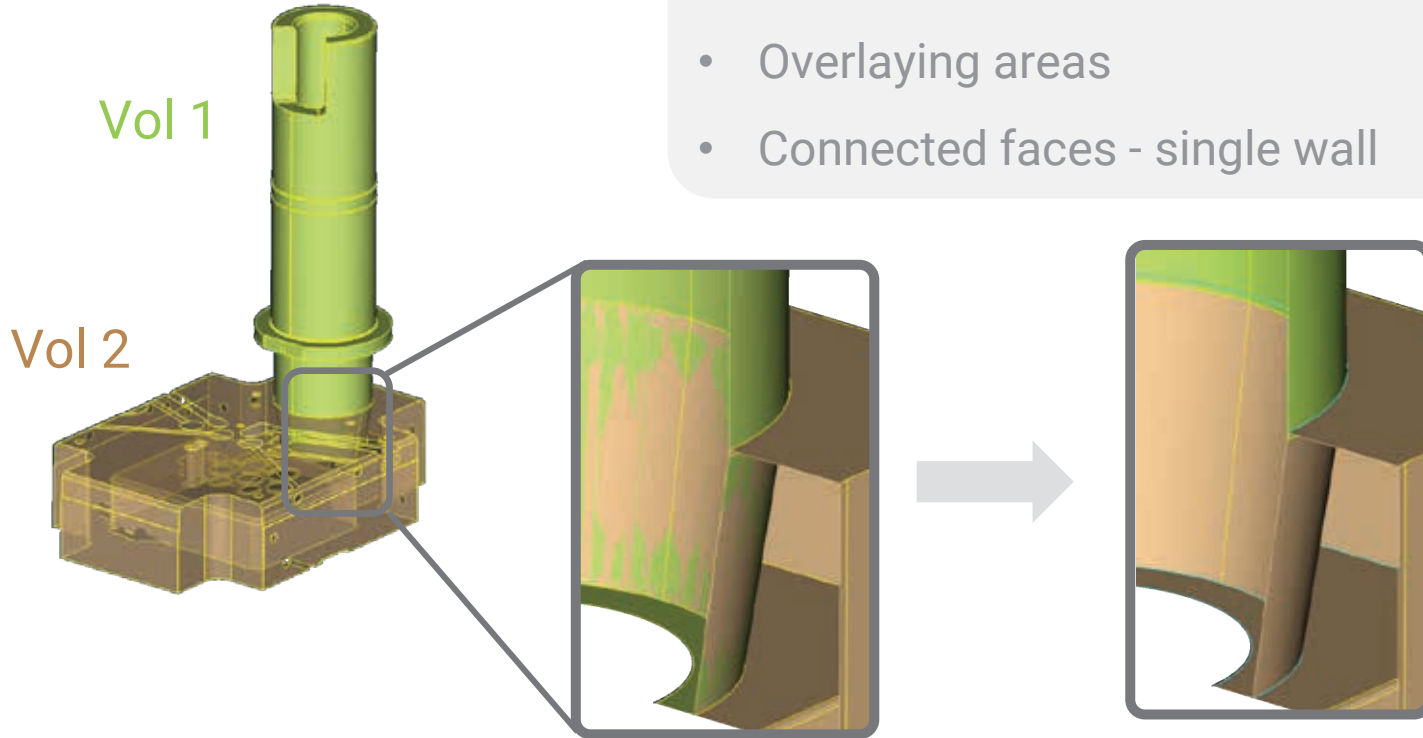
- 1. *Pre-processing challenges***
2. Why ANSA
3. Post-processing with META

The benchmark – Four metal casting cases



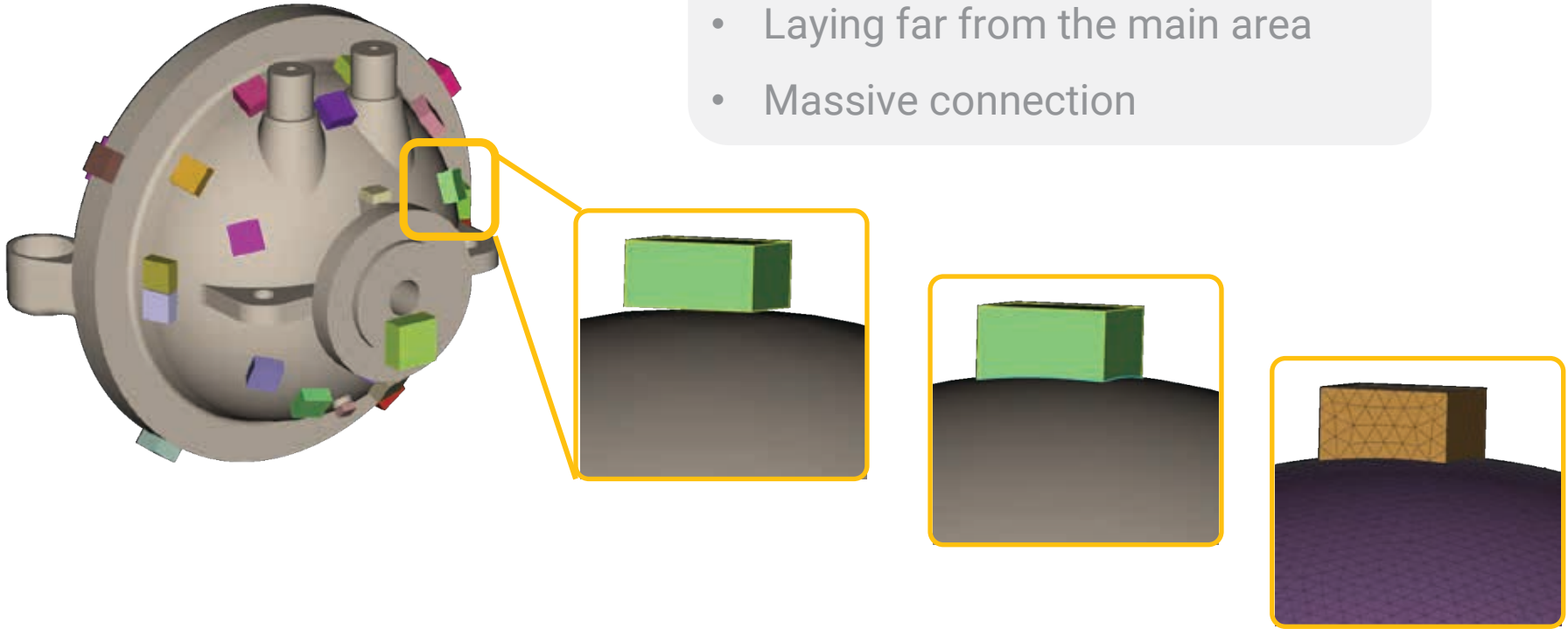
Volumes connection

- Volumes to connect
- Overlaying areas
- Connected faces - single wall

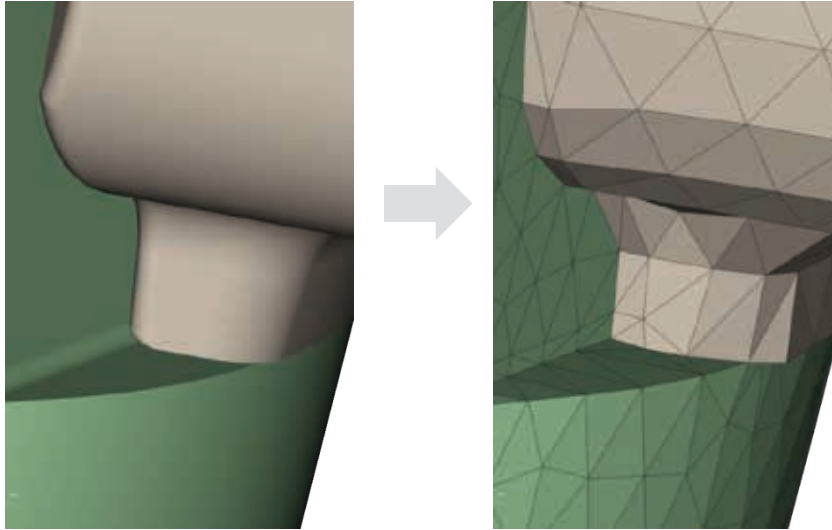


Special cases

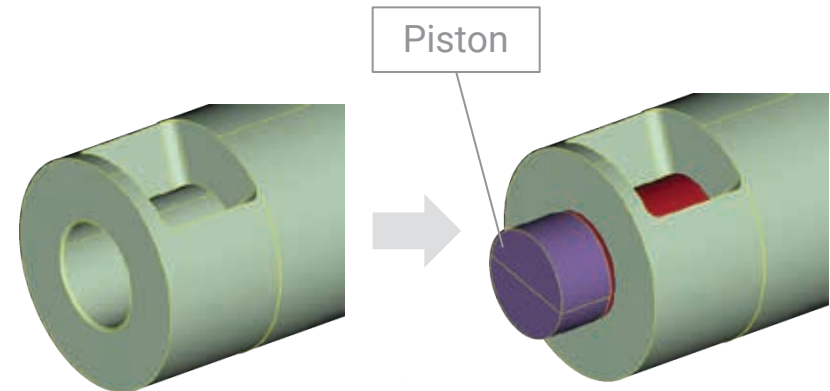
- Connect 40 “chill” volumes
- Laying far from the main area
- Massive connection



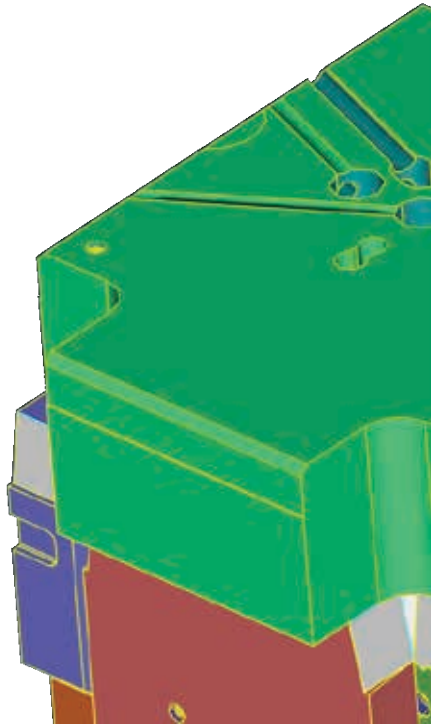
Fixing or generating CAD information



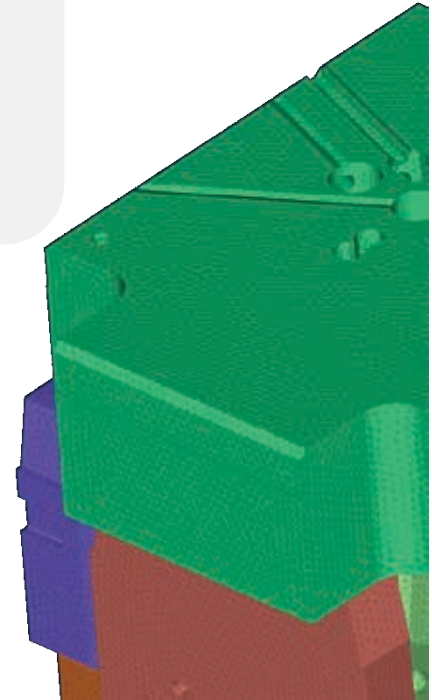
- Simplify geometry
- Create new when missing



Meshing the model



- ANSA Batch Mesh advanced tool
 - Setup once / Re-use
 - Auto-mesh for shell & solid
- Meeting mesh requirements

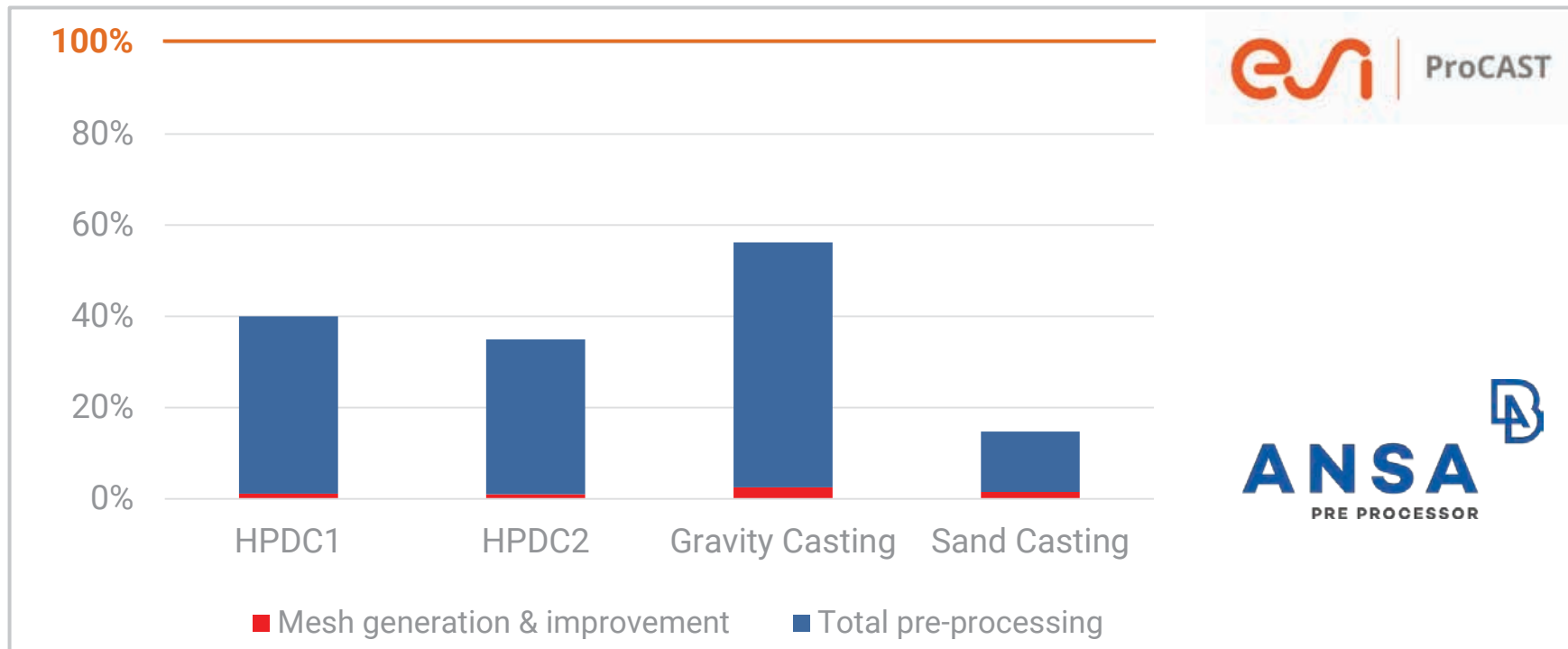


ANSA – ProCAST – META solution

1. Pre-processing challenges
2. **Why ANSA**
3. Post-processing with META

Why ANSA

➤ Time consumed using ANSA vs Visual Mesh:

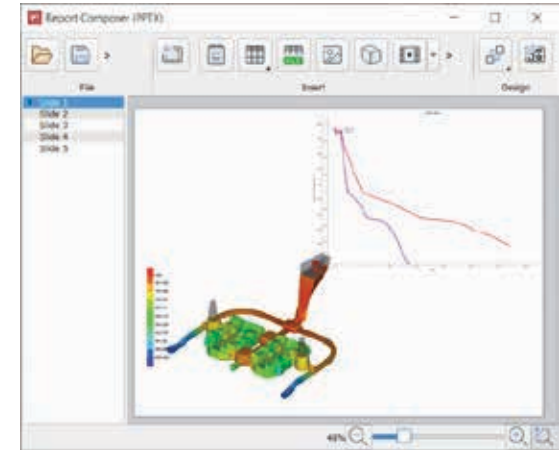
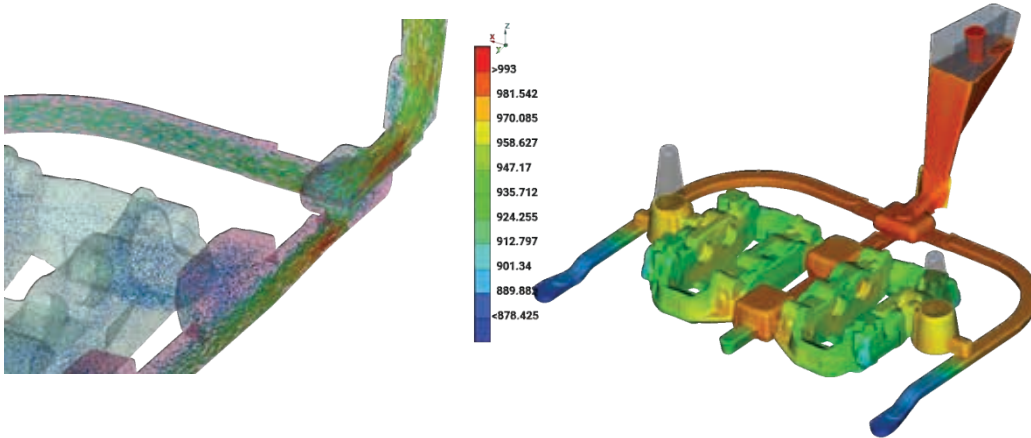


ANSA – ProCAST – META solution

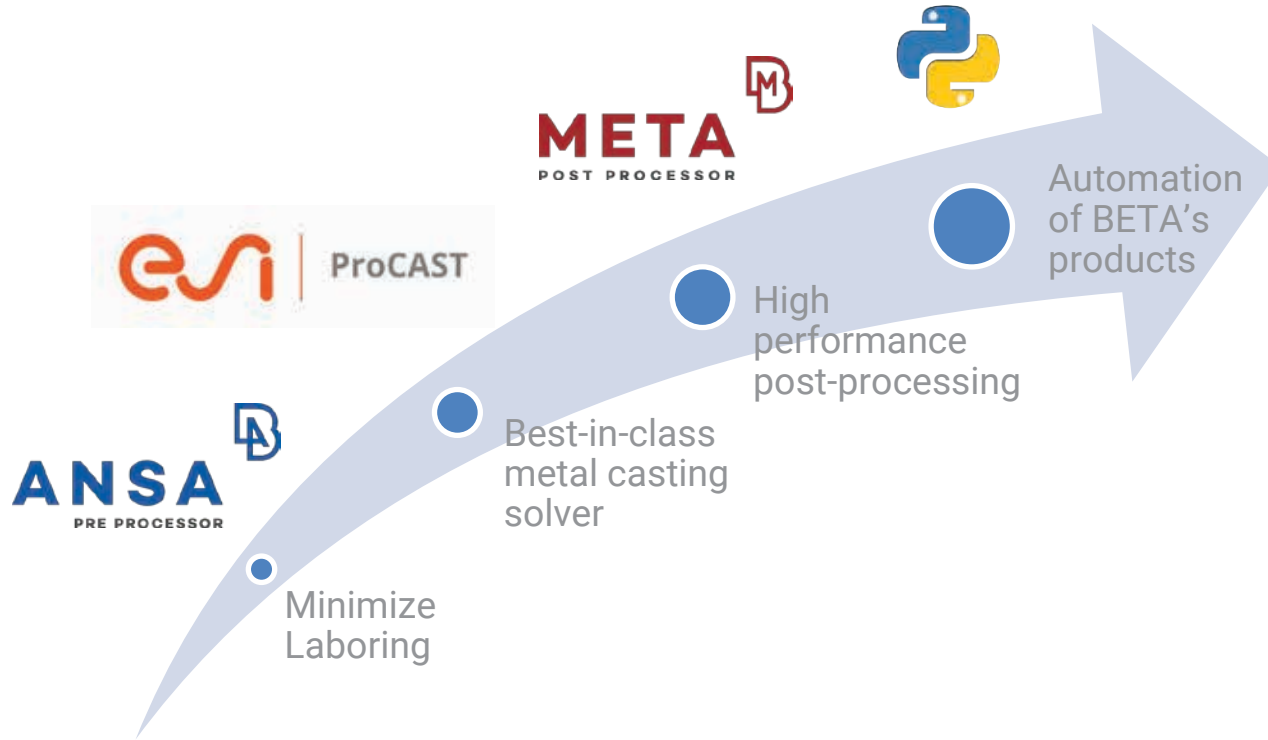
1. Pre-processing challenges
2. Why ANSA
3. ***Post-processing with META***

Post-processing with META

- Read geometry and results (.erfh5)
- Extended META functionality
- Create enhanced reports easy
- Full automation by Session files & Python API



Why ANSA – ProCAST – META solution



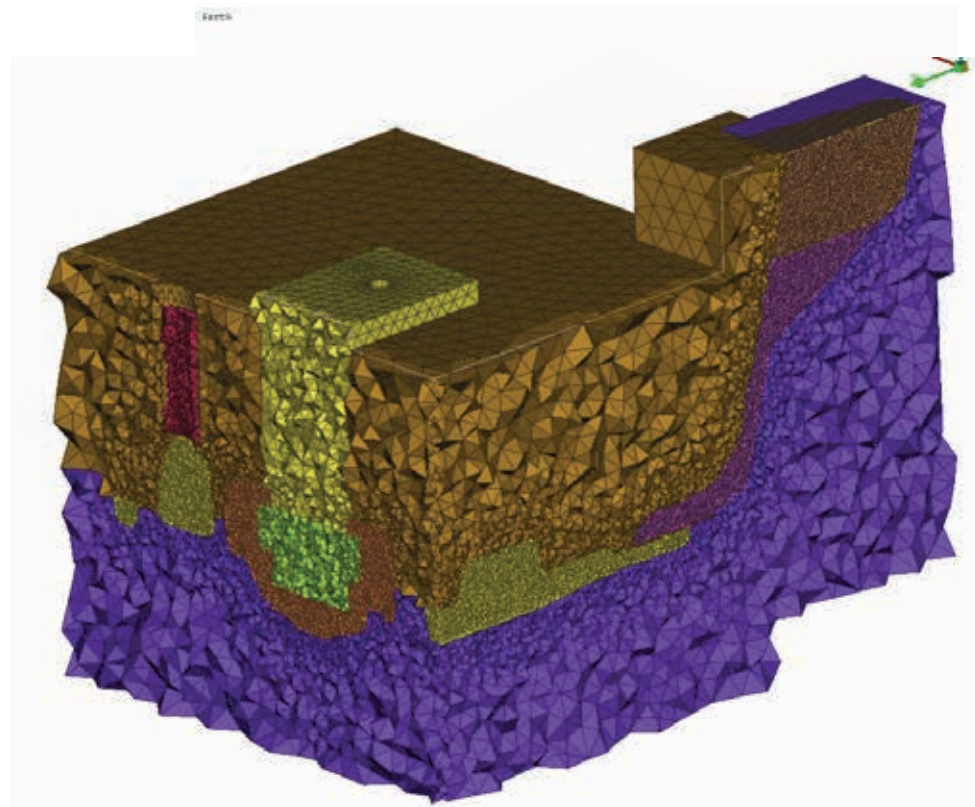
BREMBO: Automated mesh for ProCAST

1. Process Key Features

2. Automatic update of the model geometry
3. Automatic recognition of the casted volumes
4. Automatic mesh generation and output
5. Current status, Benefits and stats, Further improvements

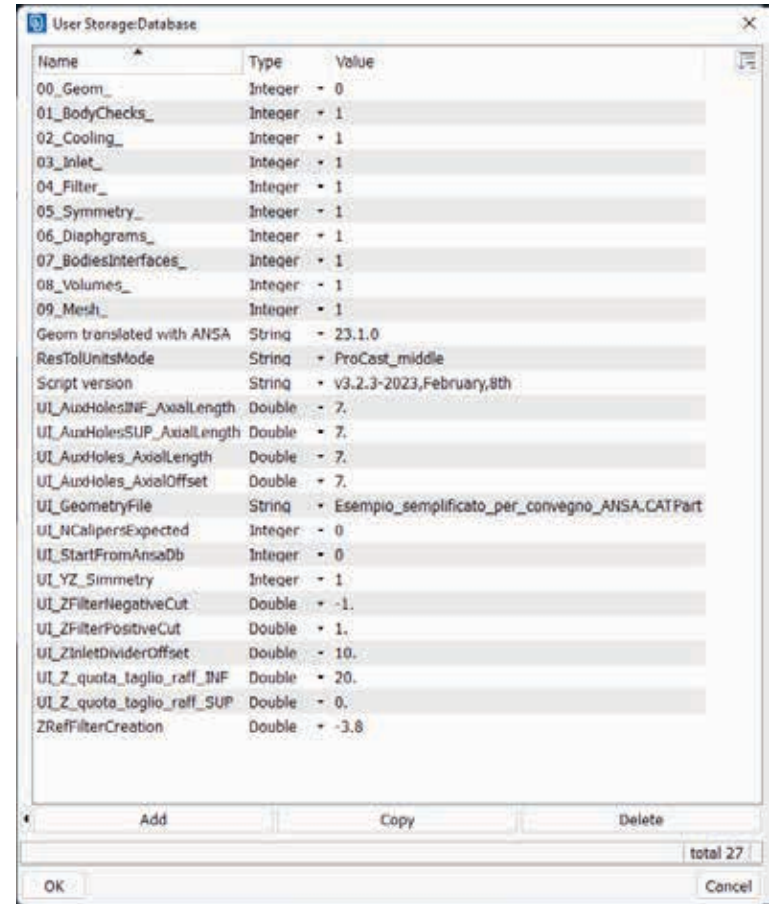
Process key features

- Reads geometry file
- Performs some geometrical updates (based on user specified parameters)
- Identifies and solves common interfaces
- Creates and outputs 3d mesh (based on user specified parameters)
- Can be executed in batch



Process key features

- Main process calls sub-processes
- Each sub-process
 - performs a specific task
 - checks correct execution of his task
 - saves an intermediate ANSA db
 - upon failure, stops main process
- Each intermediate ANSA db
 - can be used for inspection/debug
 - can be used to restart main process
 - contains process details, input parameters and check's results



The screenshot shows a window titled 'User Storage:Database' with a table of parameters. The table has three columns: 'Name', 'Type', and 'Value'. The parameters listed include various integer, string, and double values, such as '00_Geom_' with value 0, 'Geom translated with ANSA' with value '23.1.0', and 'ZRefFilterCreation' with value '-3.8'. At the bottom of the window, there are buttons for 'Add', 'Copy', and 'Delete', and a status bar showing 'total 27'.

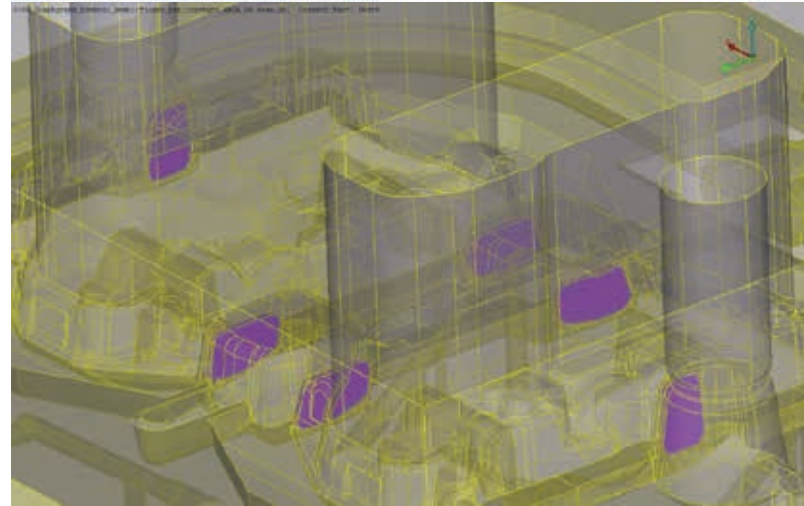
Name	Type	Value
00_Geom_	Integer	0
01_BodyChecks_	Integer	1
02_Cooling_	Integer	1
03_Inlet_	Integer	1
04_Filter_	Integer	1
05_Symmetry_	Integer	1
06_Diaphragms_	Integer	1
07_BodiesInterfaces_	Integer	1
08_volumes_	Integer	1
09_Mesh_	Integer	1
Geom translated with ANSA	String	23.1.0
ResTolUnitsMode	String	ProCast_middle
Script version	String	v3.2.3-2023,February,8th
UI_AuxHolesINF_AxialLength	Double	-7.
UI_AuxHolesSUP_AxialLength	Double	7.
UI_AuxHoles_AxialLength	Double	-7.
UI_AuxHoles_AxialOffset	Double	7.
UI_GeometryFile	String	Esempio_semplificato_per_convegno_ANSA.CATPart
UI_NCalipersExpected	Integer	0
UI_StartFromAnsaDb	Integer	0
UI_YZ_Simmetry	Integer	1
UI_ZFilterNegativeCut	Double	-1.
UI_ZFilterPositiveCut	Double	1.
UI_ZInletDividerOffset	Double	-10.
UI_Z_quota_taglio_raff_INF	Double	20.
UI_Z_quota_taglio_raff_SUP	Double	0.
ZRefFilterCreation	Double	-3.8

BREMBO: Automated mesh for ProCAST

1. Process key features
- 2. Automatic update of the model geometry**
3. Automatic recognition of the casted volumes
4. Automatic mesh generation and output
5. Current status, Benefits and stats, Further improvements

Automatic update of the model geometry

- Auxiliary hole closure
- Inlet closure/Inlet internal divider creation
- Filter creation (new internal volume)
- Symmetry (optional)
- Calipers divider creation (Diaphragms)



Automatic update of the model geometry

Each automatic update of the model

1. Is based on reference faces (identified through color coding)
 - Colors as CATIA attributes (per face, user defined)
 - ANSA reads colors during CAD Translation

Automatic update of the model geometry

Automatic update of the model geometry

Each automatic update of the model

1. Is based on reference faces (identified through color coding)
 - Colors as CATIA attributes (per face, user defined)
 - ANSA reads colors during CAD Translation
2. Has been parametrized
 - User can specify parameter's values @ASCII input file

Automatic update of the model geometry

```
1 GeometryFile;"..\Esempio_semplificato_per_convegno_ANSA.CATPart"
2 StartFromAnsaDb;0 # se "0" parte dal file .Cat
3 #
4 AuxHoles_AxialOffset;7.0 # quota di posizionamento del tappo dei raffreddamenti orizzontali
5 AuxHoles_AxialLength;7.0 # spessore del tappo creato da Ansa per raffreddamenti orizzontali, (viola scuro)
6 #-----
7 Z_quota_taglio_caff_INF;20.0 # quota inferiore, dove viene creato il tappo
8 AuxHolesINF_AxialLength;7.0 # spessore del tappo creato da Ansa per raffreddamento inferiore angolato
9 #-----
10 Z_quota_taglio_caff_SUP;0.0 # quota dal fondo della mezza inferiore, dove viene creato il tappo del maschio
11 AuxHolesSUP_AxialLength;7.0 # spessore del tappo creato da Ansa per raffreddamento nel maschio
12 #-----
13 ZInletDividerOffset;10.0 # offset del divisore di ingresso, (alto colorato di giallo)
14 #-----
15 ZFilterPositiveCut;1.0 # spessore del filtro positivo
16 ZFilterNegativeCut; 1.0 # spessore del filtro negativo
17 #-----
18 esize2d;casted_parts;3.0 # dimensione elementi getto (pinza + canali)
19 esize2d;INF;18.0 # dimensione elementi mezza inferiore
20 esize2d;ANIMA;7.0 # dimensione elementi anima
21 esize2d;SUP;18.0 # dimensione elementi mezza superiore
22 esize2d;MONALITE;7.0 # dimensione elementi montantini
23 esize2d;MASCHIO;10.0 # dimensione elementi maschio
24 #-----
25 #
26 YZ_Simmetry;0 # applica simmetria (considera mezzo stampo)
27
```

CAD to be imported (or ANSA db - restart)

Auxiliary Holes parameters

Inlet divider generation parameter

Filter creation parameters

Symmetric model generation

Automatic update of the model geometry

Each automatic update of the model is based on

1. A set of reference faces identified through colors
 - User has to define colors in the original CAD file
 - ANSA will read them during CAD import
2. A parametric definition of the update to be performed
 - User can specify parameter's values in the ASCII input file
3. An hardcoded algorithm that will perform the update
4. An hardcoded rule that feeds algorithm with the proper inputs (colored faces and user values)

Automatic update of the model geometry

BREMBO: Automated mesh for ProCAST

1. Process key features
2. Automatic update of the model geometry
- 3. Automatic recognition of the casted volumes**
4. Automatic mesh generation and output
5. Current status, Benefits and stats, Further improvements

Automatic recognition of the casted volumes

- CAD files contain only the geometry of each part of the mould.
- Each part of the mould is designed through its watertight surfaces.

Automatic recognition of the casted volumes

Proper identification/removal of the common interfaces

Automatic recognition of the casted volumes

Automatic identification of new volumes & Casted parts

BREMBO: Automated mesh for ProCAST

1. Process key features
2. Automatic update of the model geometry
3. Automatic recognition of the casted volumes
- 4. Automatic mesh generation and output**
5. Current status, Benefits and stats, Further improvements

Automatic mesh generation and output

Automatic 2d and 3d mesh generation (according to user inputs)

```
1 geometryFile;".\Esempio_semplific
2 startFromAnsaDb;0
3 #
4 AuxHoles_AxialOffset;7.0
5 AuxHoles_AxialLength;7.0
6 #
7 S_quota_taglio_raff_INF;20.0
8 AuxHolesINF_AxialLength;7.0
9 #
10 I_quota_taglio_raff_SUP;0.0
11 AuxHolesSUP_AxialLength;7.0
12 #
13 InletDividerOffset;10.0
14 #
15 FilterDerivativeCut;1.0
16 FilterNegativeCut;1.0
17 #
18 size2d;casted_parts;3.0
19 size2d;INF;10.0
20 size2d;AKIMA;7.0
21 size2d;SUP;10.0
22 size2d;MUNALIVE;7.0
23 size2d;MASCHIO;10.0
24 #
25 YZ_Simmetry;0
```

Target Element Lengths

Automatic mesh generation and output

- Generated elements can be exported for any supported solver

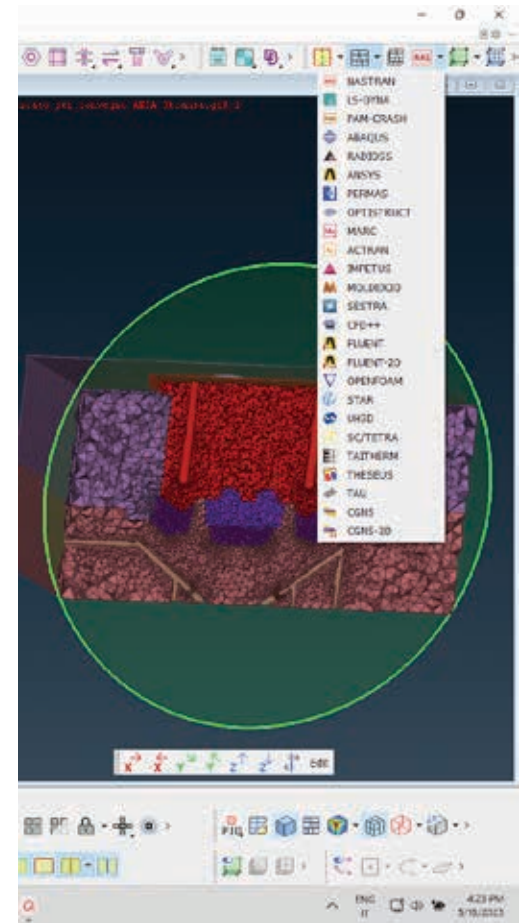
```
C:\Users\k\Documents\beta\ACS-80W_moving_CAD2D_VLW_000000_Notebook - Notebook++
File Edit Insert View (Layout) Language Settings Tools Macro Run Plugin Window

class _INTRAJ:
  #_INTRAJ_d_text_map
  #_INTRAJ_d_text_map = {
    constants.ASAQTT: base.OutputAbaqus,
    constants.ABYS: base.OutputAbaqus,
    constants.LOFT3D: base.OutputLoft3D,
    constants.SAP2000: base.OutputSap2000,
    constants.OPTISTRUCT: base.OutputOptiStruct,
    constants.FEMCRASH: base.OutputFemCrash,
    constants.XACTOFF: base.OutputRadioss,
  }

  #_INTRAJ_d_text_map
  #_INTRAJ_d_text_map = {
    constants.ABAQUS: ["ABAQUS.inp", "model", "model", "write", "model", "1"],
    constants.ABYS: ["ABAQUS.inp", "model", "model", "write", "model", "1"],
    constants.LOFT3D: ["LOFT3D.inp", "model", "model", "write", "model", "1"],
    constants.SAP2000: ["SAP2000.inp", "model", "model", "write", "model", "1"],
    constants.OPTISTRUCT: ["OPTISTRUCT.inp", "model", "model", "write", "model", "1"],
    constants.FEMCRASH: ["FEMCRASH.inp", "model", "model", "write", "model", "1"],
    constants.RADIOSS: ["RADIOSS.inp", "model", "model", "write", "model", "1"],
  }

  #_INTRAJ_d_output_params
  #_INTRAJ_d_output_params = {
    constants.ASAQTT: ["INTRAJ.d_text_map", "model", "model", "write", "model", "1"],
    constants.ABYS: ["INTRAJ.d_text_map", "model", "model", "write", "model", "1"],
    constants.LOFT3D: ["INTRAJ.d_text_map", "model", "model", "write", "model", "1"],
    constants.SAP2000: ["INTRAJ.d_text_map", "model", "model", "write", "model", "1"],
    constants.OPTISTRUCT: ["INTRAJ.d_text_map", "model", "model", "write", "model", "1"],
    constants.FEMCRASH: ["INTRAJ.d_text_map", "model", "model", "write", "model", "1"],
    constants.RADIOSS: ["INTRAJ.d_text_map", "model", "model", "write", "model", "1"],
  }

def ExportOutputParams(OutputParams[constants.ASAQTT]):
  TermsIterator, nT = CreateFunctions_GetDataIteratorOfOutput_Domains[BASE, None, 'TEXT']
  if nT != base.Faces[base.OutputParams[constants.ASAQTT]]:
    for OutputDeck in OutputParams:
      for n in base.Collections[base.OutputParams[constants.ASAQTT]]:
        n.set_entity_values(OutputDeck, ['TEXT'])
      if OutputDeck == constants.SAP2000:
        for n in base.Collections[base.OutputParams[constants.ASAQTT]]:
          n.set_entity_values(OutputDeck, ['TEXT'])
    _INTRAJ.d_output_params[constants.ASAQTT] = os.path.join(_GlobalVars_CatiaFileDir, _GlobalVars_CatiaFileTheme, _INTRAJ_d_text_map[OutputParams])
    _INTRAJ_d_TEXT_MAP[OutputParams] = _INTRAJ_d_output_params[OutputParams]
  return 0
```



Automatic mesh generation and output

- Generated elements can be exported for any supported solver
- For compatibility reasons with Visual Mesh, the output format currently selected is ABAQUS since it allows fast retrieving in Visual Mesh of different volumes based on different dummy materials and properties defined in ANSA

BREMBO: Automated mesh for ProCAST

1. Process key features
2. Automatic update of the model geometry
3. Automatic recognition of the casted volumes
4. Automatic mesh generation and output
5. **Current status, Benefits and stats, Further improvements**

Current status, Benefits and stats, Further improvements

Current status description

- Ongoing test campaign based on
 - 6 real models (process development references)
 - 23 real models (not shared)
 - 1 simplified model (used for ppt images creation)
- Both *Symmetric/Full Model* options tested (when possible)
- Ongoing comparison at PROCASST results level

Current status, Benefits and stats, Further improvements

Benefits

- Mesh generation speed up
 - from 4-8 to 0.5-2 hours (model dependent)
 - From manual work to batch execution
- Same mesh quality evaluation (ANSA vs Visual Mesh/ProCAST)
- Overall mesh quality slightly increased

Statistics

Out of 30 tested models

- 1 model fails (new geom update rule is required)
- 2 models requires process restart
 - Initial Geometry must be manually fixed in ANSA after translation
- 27 models successfully meshed by the process

Current status, Benefits and stats, Further improvements

Further improvements

- Small updates @2d mesh generation level
 - Inlet mesh sub-region definition (detailed BC setup)
 - Thermocouples activation/deactivation (control nodes required)
- ANSA ProCAST deck would enable
 - material properties and BCs setup (heat exchange, initial temperatures, velocities....)
 - ProCAST ready to run solver file generation
- Interactive face's selection in ANSA would
 - simplify process setup
 - enable check and geometry fix of the translated CAD



Stay connected