Non Conventional Metalforming Process Automation

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MFM GUI components

- PMGr tab
- PMGr Panel
- MFM Toolbar containing:
  - Forming Strategy Tree
  - Contextual Button Box
AGUSTA MFM GOAL

Agusta Metal Forming Manager (Agusta MFM) is an application intended to guide CAE analysts to design, manage and review forming processes for all products made by AgustaWestland, by modeling each production technology.
MFM main features

MFM application guides users to:

- Analyze a component starting from its CAD in order to verify forming feasibility (One Step Analysis) and to obtain the blank shape;
- Build a multi-stage forming strategy, by defining a forming technique for each stage (Sigle Action Draw, Double Action Draw, etc)
- Assign to each stage a shape from which to create die tools
- Setup stage problems
- Run and post stage problems
- Create stage reports
ADM integration

The main aim is to upload the entire project folder and data into ADM by mapping forming strategy project files with ADM entities.
Define and study Forming Strategy
Load/Save Forming Strategies
Create/import Product CAD
Create/import initial blank CAD
Perform inverse analysis
Define stages sequences
Save/Load
Forming Strategies
Computing stages simulations
Query strategies
Performance analysis
Multistage Forming Strategy

Process designers should answer to the following questions:

– How many stages the forming strategy is made by?
– Which type of operation is performed in each stage?
– What is the product shape of each stage?
How many stages?

**Strategy 1**

1. OP10
2. OP20
3. OP30

**Strategy 2**

1. OP10
2. OP20
What is the product shape of each stage?

Drawing tools will be created starting from the mesh of final product. Users will create the product of each forming stage by using HyperMorph. Then, by using HyperForm automations (i.e. Tool Build), the shapes of forming tools will be derived semi-automatically (Punch, Die, Blank holders).
What is the product shape of each stage?

Morph shapes

OP10 Deep Drawing

OP 30 Top Rib
= final Product

OP20 Lateral Rib
Forming Strategy

OP10 Deep Drawing

OP20 Lateral Rib

OP30 Top Rib
= Final Product
Stage setup workflow

Stage made shape

Import stage shape

Import blank

Dynain from prev. Stage OR INITIAL BLANK

HF Tool Build

Simulation Setup

HF Auto Process

Auto Positioning

Post Process

Run

[Graph showing strain vs. minor strain with markers for different stages]
Let’s suppose we have a forming strategy made of 2 forming operations named:

- OP_10_DAD
- OP_20_DAD
Using HyperMorph to assign stage shapes

Metamodel

Create morphing shapes from meta-model

Assign each shape to a forming stage

OP_10_DAD  OP_20_DAD
Setup Stage Problem

Stage shape (meta-model)

Stage tools

Problem setup
All project files are organized into a project directory.
• Project folder contains:
  – Pmgr instance file (.pmi)
  – Blank.hf (hyperform file for blank model)
  – Blank.dynain (initial blank in ls-dyna format)
  – Model.hf (hyperform file for meta-model)
  – Stages folders (in the example: OP_10_DAD, OP_20_DAD)
  – OneStep folder (1Step)
Stage Folder

- Stage model it is automatically saved at some key points, during editing:

```plaintext
metafile.hf  tools.hf  problem.hf
```
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