Chair of Metal Forming and Casting
TUM School of Engineering and Design
Technical University of Munich

Inverse optimization of the die-casting-straightening process chain with consideration of uncertainties

Motivation

- Large-scale process chains in the die-casting of aluminum structural components.
- Established and growing demand, particularly in mega- and gigacasting.
- Straightening is essential but difficult to automate and time-consuming.
- Distortion arises from both deterministic and stochastic distortion influences throughout the process chain.

Fundamentals

- Die casting is a highly dynamic and turbulent process.
- Straightening is an industrial process, often performed manually
- Key optimization objectives include mechanical properties, dimensional accuracy, process time and robustness.

Methodology (Phase I)

- Development of an inversely solvable framework:
  - Inverted finite element solver for elasto-plasticity and heat transport
  - Inverse-solvable die filling simulation
  - Bidirectional coupling and uncertainty propagation
- Process chain modelling for component geometry typical of structural parvts:
  - Integration of suitable in-line sensors and actuators
  - Holistic analysis of the overall process chain
- Experimentally validated, inversely solvable process chain model
- First cross-process optimization with respect to mechanical properties, dimensional accuracy and cycle time

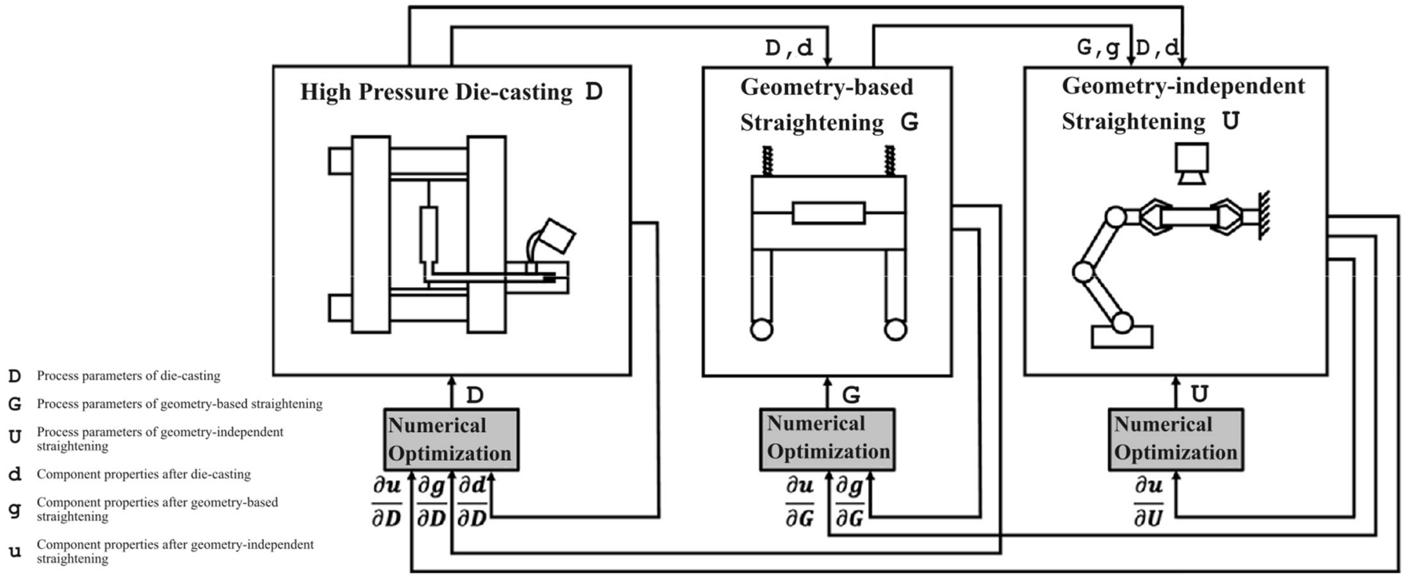

Figure 3: Schematic of the inversely solvable overall model.

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