OPTIMISING FORMING PROCESS BEHAVIOR USING ARTIFICIAL INTELLIGENCE

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Motivation and Research Objectives

- Forming process - used to shape flat sheets of material into three-dimensional components
  - Stamp Forming - using a stamping press as in Fig 1
  - Diaphragm Forming - using a diaphragm or flexible membrane

- Artificial Intelligence - to increase the simulation accuracy of forming process
  - Optimisation - to improve simulations and time for computations, while reducing the cost
  - Defect Detection - to overcome defects by detecting them at early stage of design, using point cloud as shown in Fig 2

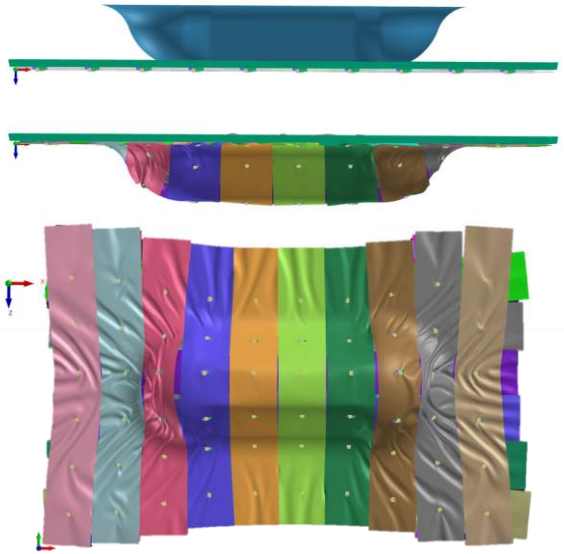

Fig 1: Stamp Forming

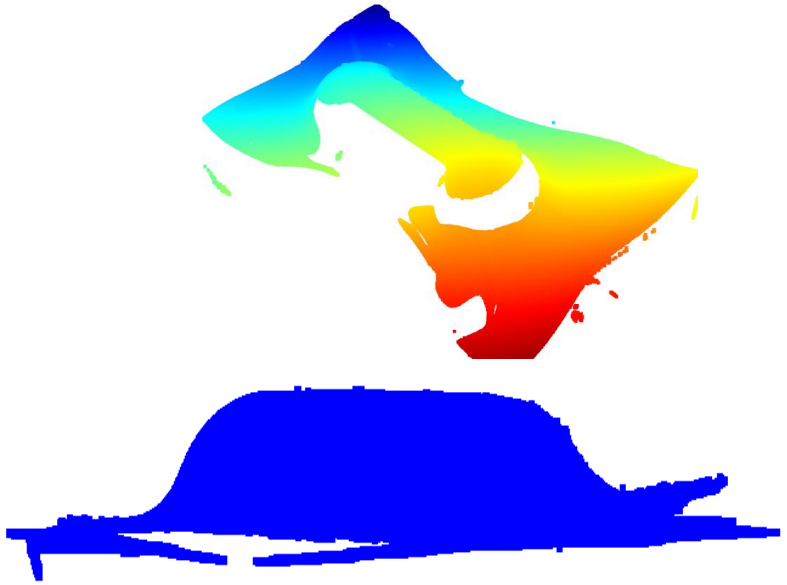

Fig 2: Point Cloud Scanned

Introduction

- Simulation-driven evaluations help in reducing the cost of forming processes by various Artificial Intelligence based optimisation steps as illustrated in Fig 3.
- Several Machine Learning techniques such as Genetic Algorithm are used to predict and classify forming behavior.
- Induced forming defects, such as wrinkles, bridging, voids, are optically inspected using point cloud-based system.

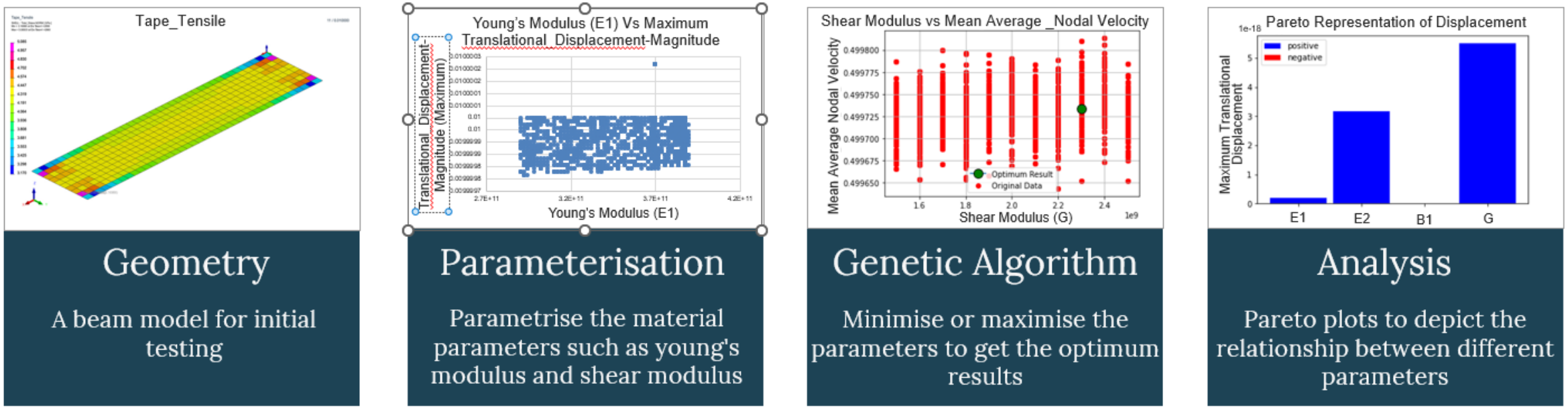

Fig 3: Process Chain

Initial Evaluations

- Optimisation - Multiple Linear Regression (MLR) is implemented for curve fitting and Multi-objective Genetic Algorithm (GA) for finding optimas. Pareto plots and Open-source tools like Para View and HDF View are used for visualisations of simulations as seen in Fig 4.

- Defect Detection - Defects are detected by analysing the surface normal. The normal vectors for the simulation and point cloud are compared and visualised as in Fig 5.

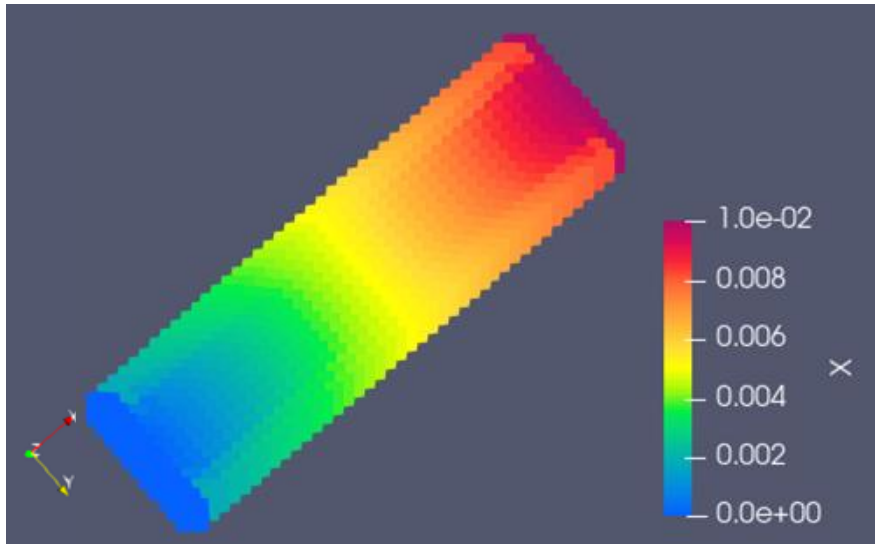

Fig 4: Beam Visualisations

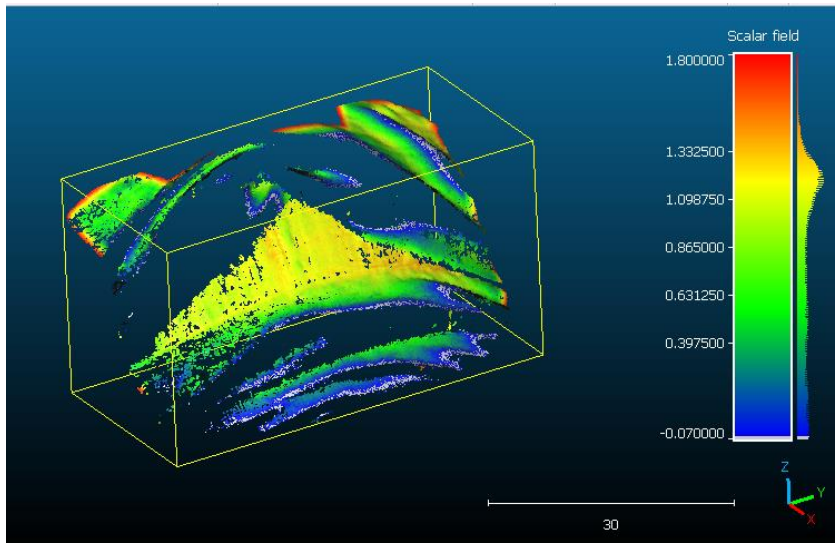

Fig 5: Cloud Compare

Results and Future Outlook

- The optimisation tool has been deployed for a beam model, now it is being validated on a Double Dome geometry as displayed in Fig 6.
- The scanned points are being removed based on an angle threshold as in Fig 7. Additionally, preprocessing techniques such as Octrees, multithreading, KNNs, and distance threshold are used.

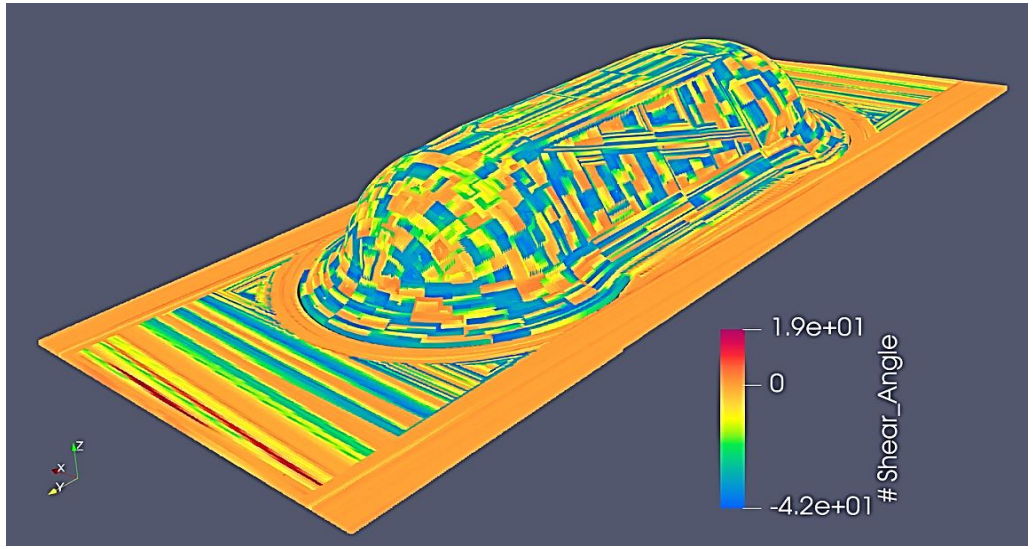

Fig 6: Double Dome Visualisation

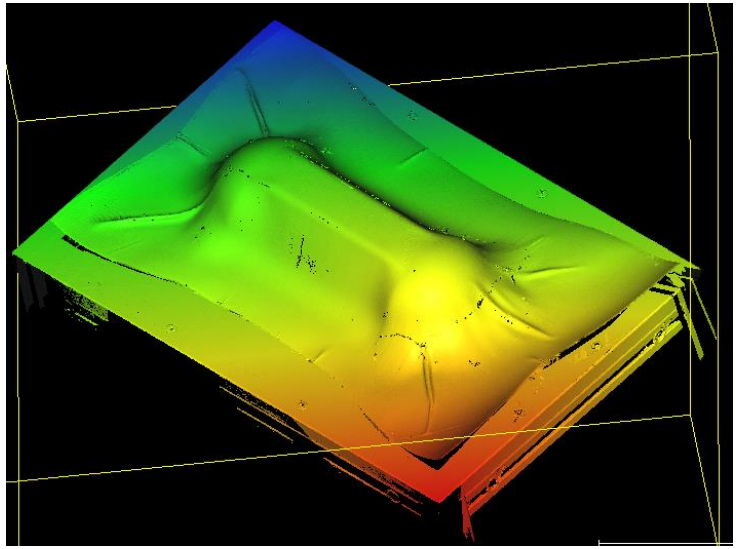

Fig 7: Point Cloud Visualisation

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Thank you