



Newsletter #2

Digital Twins for real-time quality assessment



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Digital Twins for real-time quality assessment:

Manufacturing efficiency hinges on the quality of produced parts. Traditionally, quality control relies on operator experience and random sampling. However, the industry is increasingly embracing digital twins (DTs) for real-time quality assessment. DTs process data collected from the manufacturing process, feeding it into a model to make predictions. This proactive approach enables early identification of potential quality issues, leading to timely corrective actions.

Within the metaFacturing project, we are working on a DT that uses thermal camera measurements, where the DT has 2 primary objectives:

- a. **Material Parameter Characterization:** accurately determining thermal conductivity and heat capacity.
- b. **3D Temperature Profile Estimation:** visualizing and analyzing the temperature distribution within the part.

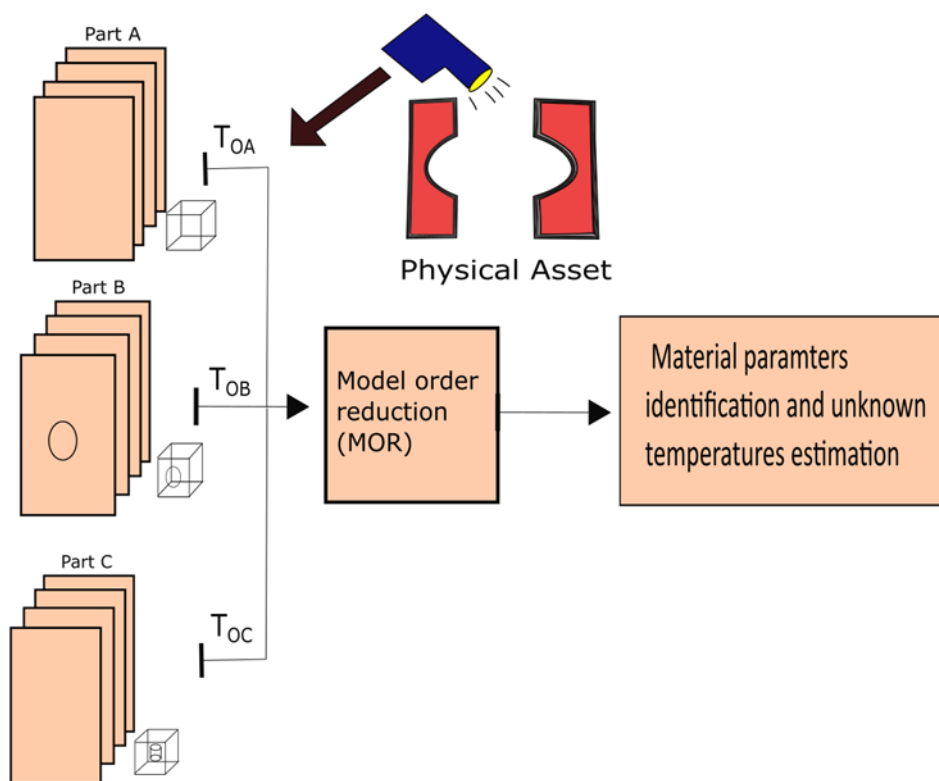
The figure provides a layout of the proposed framework. A Thermal camera is used to take multiple images during a production cycle. Each pixel point in the image can be considered as a temperature sensor.



metaFacturing

Such dense temperature measurements contain essential information about the part quality, which is coupled with an inverse optimization technique to identify material parameters and estimate the unknown temperature states.

However, directly coupling thermal images with an inverse method is computationally intensive, increasing the processing time. Therefore, a model order reduction (MOR) technique is applied to reduce the processing time.



In metaFacturing, the framework was validated using synthetic data (i.e. finite element results).

The next phase involves real-world testing in collaboration with LKR. By integrating the DT in a lab environment, we aim to further refine and optimize its capabilities.