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Application of Simplicial Functional Data Analysis to Statistical Process Control in Additive Manufacturing

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Industrial production processes are becoming more and more flexible, allowing the production of geometries with increasing complexity, as well as shapes with mechanical and physical characteristics that were unthinkable only a few years ago: Additive Manufacturing is a striking example. Such growing complexity requires appropriate control quality methods and, in particular, a suitable Statistical Process Control framework. In this contribution, we will illustrate a novel method, designed to deal with the problem of identifying geometrical distortions and defects in arbitrarily complex geometries, which come in the form of reconstructed meshes or point clouds. We model geometric distortions based on the definition of Hausdorff distance, avoiding any simplifying assumption on the shapes being analysed, and we inspect such distortions using tools coming from the theory of statistical analysis in Hilbert spaces. We test the performance of the method on a real dataset, consisting of trabecular egg shells, which are a good benchmark of the complexity which can be reached in real industrial processes.

Primary authors: SCIMONE, Riccardo (Politecnico di Milano); Dr TAORMINA, Tommaso (Dipartimento di Meccanica, Politecnico di Milano); Prof. COLOSIMO, Bianca Maria (Dipartimento di Meccanica, Politecnico di Milano); Dr GRASSO, Marco (Dipartimento di Meccanica, Politecnico di Milano); MENAFOGLIO, Alessandra (MOX, Department of Mathematics, Politecnico di Milano); SECCHI, Piercesare (MOX, Department of Mathematics, Politecnico di Milano)

Presenter: SCIMONE, Riccardo (Politecnico di Milano)

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