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Video/Image Statistical Process Monitoring in Additive Manufacturing via Partial First Order Stochastic Dominance

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The continuously evolving digitalized manufacturing industry is pushing quality engineers to face new and complex challenges. Quality data formats are evolving from simple univariate or multivariate characteristics to big data streams consisting of sequences of images and videos in the visible or infrared range; manufacturing processes are moving from series production to more and more customized applications. In this framework, novel methods are needed to monitor and keep under statistical control the process. This study presents two novel process monitoring techniques that rely on the partial first order stochastic dominance (PFOSD) concept, applicable to in-line analysis of video image data aiming at signaling out-of-control process states. Being non-parametric, they allow dealing with complex underlying dynamics and wildly varying distributions that represent the natural process conditions. A motivating case study in metal additive manufacturing is presented, where the proposed methodology enables the in-line and in-situ detection of anomalous patterns in thermal videos captured during the production of zinc samples. Performances are investigated and compared in the presence of both simulated and real data.

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