

Monitoring systems are becoming extremely useful in additive manufacturing to ensure print accuracy, quality and its reliability. This thesis presents a computer vision based in-situ process monitoring systems which works collaboratively with Fused Filament Fabrication (FFF) 3D printing for defect detection and assessment for print quality. The work comprises of two components: a digital reference model generated from G-code and synchronized stereo system which captures images using low-cost, off-the-shelf cameras aligned with the build volume. Additionally, this work provides a comprehensive framework for developing such monitoring systems. These images acquired are processed into a 3D point cloud to reconstruct the printed surface, which is then compared with the reference model generated from Gcode by a matching algorithm to identify any geometric deviations to quantify geometric deviations such as under-extrusion, missing features and layer shifts . The resulting spatially resolved quality metrics supports human-in-the-loop decision-making process to determine the quality of the part. These results or extracted features can be further used to train machine learning models for automated defect classification and root cause analysis. The proposed approach offers a scalable, cost-effective solution for quality control, contributing to the advancement of autonomous monitoring in additive manufacturing.