Planar sliced layer decomposition strategies applicable for large scale additive manufacturing using robots

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Additive Manufacturing (AM) using multiple robots requires task area allocation algorithms to divide the work between the robots. In this seminar, three types of layer decomposition strategies were presented for part printing with dual serial manipulators for work division, such as (1) Corrugated Partition for Intersected Sandwich Layers (CPISL), (2) Equal Task Area Allocation (ETAA), and (3) Unequal Task Area Allocation (UTAA). These layer decomposition methodologies are developed to decompose part volume into sub-volumes for task allocation to dual robots while simultaneously increases the bonding. All three methodologies address the bonding issue between the printed sub-volumes and it also enhances the process speed for better productivity. The first strategy, CPISL methodology uses corrugated partition for decomposition and we have observed an increase in bonding between the decomposed sub-volumes. From the print time analysis of several tessellated models, a 30 to 45% of reduction in the print time is also obtained. The ETAA is applicable for smaller size tessellated models, because it fits within the intersection work volume of the adjacent robot arms. The bonding is extremely high in this approach but there is a possibility of higher collision rate due to simultaneous printing in the intersection work volume, and there is a reduction of print time between 25 to 35% for multiple models. While the third strategy, UTAA is applicable for large size tessellated models because it can handle larger part volume compared to the intersection work volume of the robot arms. The print time reduction in UTAA lies in between the CPISL and ETAA strategies, but the bonding of the printed sub-volumes is better compared to CPISL methodology. In order to understand the efficacy of the developed work allocation strategies, validation studies are carried out by part printing with dual serial manipulators. In this work, the dobot arms are used for validation of the proposed strategies, which are placed at a distance of 400 mm between them. A unified software interface is developed to control dual robot arms and the extruder attached to its end effector for material extrusion application.