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Effects of Process Parameter Variation on the Surface Roughness of Rapid Prototyped Samples Using Design of Experiments

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Abstract : Rapid prototyping (RP) is an additive manufacturing technology used in industry that works by systematically depositing layers of working material to construct larger, computer-modeled parts. A key challenge associated with this technology is that RP parts often feature undesirable levels of surface roughness for certain applications. To combat this phenomenon, an experimental technique called Design of Experiments (DOE) can be employed during the growth procedure to statistically analyze which RP growth parameters are most influential to part surface roughness. Utilizing DOE to identify such factors is important because it is a technique that can be used to optimize a manufacturing process, which saves time, money, and increases product quality. In this study, a four-factor/two level DOE experiment was performed to investigate the effect of temperature, layer thickness, infill percentage, and infill speed on the surface roughness of RP prototypes. Samples were grown using the sixteen different possible growth combinations associated with a four-factor/two level study, and then the surface roughness data was gathered for each set of factors. After applying DOE statistical analysis to these data, it was determined that layer thickness played the most significant role in the prototype surface roughness.

Keywords : rapid prototyping, surface roughness, design of experiments, statistical analysis, factors and levels
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