Departmental Seminar

Seminar Title	: A Hybrid Approach for Machining Optimization of Inconel 925 Using Simulation-Assisted Taguchi and GRA-RSM Techniques
Speaker	: Abhisek Panigrahi
Supervisor	: Prof. Saurav Datta (2524), PIC Departmental Seminar
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Abstract	: This study outlines a systematic method for enhancing the machining performance of Inconel 925, a nickel-based superalloy recognized for its superior mechanical strength and corrosion resistance, yet characterized by challenging machinability. A simulation-based and experimental methodology was utilized to tackle the challenges related to machining Inconel 925. Machining simulations were first performed using DEFORM-3D software to predict and analyze process behavior across different cutting conditions. The insights guided the experimental design and minimized trial iterations. A structured design of experiments (DOE) was established using a Taguchi L16 orthogonal array to systematically investigate the impacts of prominent input variables: speed, feed rate, and depth of cut, under flood cooling conditions. A cutting tool with PVD coating was utilized to enhance wear resistance and machining efficiency. The output responses measured comprised cutting force, roughness of cutting surface, tool wear, and material removal rate (MRR). These responses are critical indicators of machining performance and part quality. In order to determine the optimal machining parameters for multi-response optimization, Grey Relational Analysis (GRA) was implemented. The links between input parameters and output responses were then modeled and analyzed via refinement using Response Surface Methodology (RSM). The reliability and efficacy of the selected process parameters were increased by the combination of GRA and RSM, which created a robust framework for the simultaneous optimization of numerous outputs. This study emphasizes the innovative integration of simulation, Taguchi Design of Experiments, and advanced optimization techniques in the machining of Inconel 925, resulting in notable enhancements in performance metrics. Utilizing DEFORM-3D simulations before conducting physical experiments effectively decreased material and time expenditures while facilitating enhanced process control accuracy. The findings provide significant insights for industries involved in the high-performance machining of challenging materials.