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Overview of Turn-Milling Machining Processes – A review

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Abstract. Comprehensive study of advances in the machining process is the ever-existing need of the hour, even in spite of emerging technologies like additive manufacturing which are in trends. Turn-mill machining operations which are of either with self-propelled cutter or active-driven cutters are termed to be a hybrid of turning and milling processes. To enhance the turn-mill operations, a vertical milling machine with A-axis, C-axis (4-axis machine tool), 5-axis/6-axis machine tools are required. The turn-mill operations offer advantages of successfully machining complex curvatures and thin plates. This process application is limited, as its kinetics and dynamics are complex and need to be understood much more. This review paper attempts to summarize the works carried out in the turn-milling operational processes such as orthogonal and tangential machining. Primarily, the self-propelled rotational turn-mill tools are outlined and thereby addressing actively driven tools, basing on analytical and experimental models of representing the process. The responses studied under turn-mill operations are presented with applications, and overviewing all the optimization methods applied. The research findings are summarized and introduced with an intention to understand the feasibility turn-mill operations, so that it can be used in industries as an alternative for rotating tool machine tools such as milling and grinding.

Keywords: Active driven rotary tool; multi-axis machining; self-propelled tools; Turn-mill.

INTRODUCTION

The material machining processes do not lose their importance, in-spite of inevitable loss of material as waste due to perfection and consistency in component geometry. In-addition, the cost effectiveness, labour and time of manufacturing is very eased in material machining processes. Apart from it, hard materials do raise question of their manufacturing rigidity due to their higher strengths and temperature of melting, to which modern machining technologies such as machine tools like computer numerical control machine tools are the answers. The integrity of proper machining process parameters in any of the machining processes, do give best in minimizing machining responses which deteriorates the machine and its performance. Hence there is a need to find the optimal process parameter combinations to achieve the right responses from the material machined components.

Computer numerical control (CNC) turn-mill machine tool, is a multitask machine which perform superior turning and edge operations. This hybrid trendy machine tool is powered by a CNC system combining each option and advantages of milling and turning machines. The rotation of the cutting tools as in milling machines and rotation of workpiece as in lathe machine are accessible simultaneously in CNC turn mill machine tool. The advanced and speedy machining operations within the CNC turn-mill machine are flexible, powerful, and economical and supply even more ideal accuracy than typical machining technologies. Sustainable manufacturing demands environmental safety, optimized cost and energy requirement economics, productivity, and quality with reduced process waste. These requirements paved manufacturing industries to embrace technologies and methods that bring them towards sustainable manufacturing and focusing on processes such as turn-milling to address the consumer's needs in component quality and producers' requirement of low resource utilization is gaining momentum. Therefore, machine tools having combination of multi-operations with lesser setup time, ability to handle complex shapes and challenges to cut hard metals are now being investigated with optimal process parameter combinations. The review of the "turn-

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