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Editorial

Metals Machining—Recent Advances in Experimental and Modeling of the Cutting Process

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1. Introduction and Scope

Metal machining involves severe loading in the cutting zone. Work-material behavior, cutting tool characteristics, cutting conditions, and configuration all have effects on cutting process performance, machined part quality, and cutting cost. In the last few years, serval studies have been conducted to understand the physical phenomena that occur when metal-based materials are machined. However, a great deal remains unclear because newly developed, high-performance metals are not being controlled for machinability (excessive wear, built-up edge formation, surface integrity degradation, chip fragmentation difficulty, etc.). For instance, the mechanisms of microstructure evolution of machining metals having complex microstructures are not clearly explained (e.g., is there recrystallization or not?). Thus, the area of study of cutting phenomena in metal machining remains open.

The present Special Issue focuses on the machining of metal-based materials. It covers broad topics such as metal machinability, work-material behavior effect, tool wear, surface integrity, effects of cutting conditions, and cutting process optimization.

2. Contributions

The present Special Issue includes six scientific papers (Koklu and Basmaci [1], Razak et al. [2], Russo Spena [3], Toulfatzis et al. [4], Abbas et al. [5], James and Annamalai [6]) mainly covering metal machinability analyzed by experimental means. In order of publication:

- Koklu and Basmaci [1] studied the effects of tool path strategy and cooling conditions on the cutting force and surface quality in micromilling operations.
- Razak et al. [2] studied the effects of feed rate on tool deterioration and cutting force during the end milling of a 718Plus superalloy using a cemented tungsten carbide tool.
- Russo Spena [3] studied the CO_2 laser cutting of hot stamping boron steel sheets and analyzed the effects of cutting conditions (laser power and cutting speed) on the surface profile quality.
- Toulfatzis [4] studied the machinability of eco-friendly lead-free brass alloys and proposed an optimization of cutting force and surface roughness.
- Abbas et al. [5] proposed an artificial intelligence monitoring of hardening methods and cutting conditions and their effects on surface roughness, performance, and finish turning costs of solid-state recycled aluminum alloy 6061 chips.
- James and Annamalai [6] studied the machinability of the developed composite AA6061-ZrO_2 and analyzed the influence of MQL (minimum quantity lubricant) on the cutting process.

3. Conclusions and Outlook

All of these papers focus on experimental aspects of metal machining (instrumented tests and ex-situ characterization). The papers confirm a need for experimental data in the field of machining to understand the physical phenomena involved in the machining processes and, ultimately, to optimize cutting operations. The wide range of possible machining configurations ensures that many experimental studies, such as those of the present Special Issue, can be conducted.

In view of recent developments in the field of manufacturing, it is important to point out the interest in modelling approaches that support experimental testing, which can be introduced for improving machining operations (e.g., cutting tool design, tool life estimation, surface integrity evaluation, optimal cutting conditions determination, etc.). This allows the testing of virtual situations which can sometimes replace experimental tests. This functions as a way to reduce the need for tool and machine prototypes, as well as tests of machinability.

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