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RUI (2018 – 2020)

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Bridging Grant (2018-2019)

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Visitor 1

On 3rd of May 2018, delegates from UiTM Shah Alam and Chemnitz University of Technology, Germany headed by Associate Profesor Dr. Ing Yupiter (UiTM) and Prof. Dr. Ing Birgit (CUT) respectively have visited the School of Mechanical Engineering and Metal Forming Laboratory. The visit is to see our facilities on metal forming and to find potential area for collaboration in the future. They show interest in the research that is conducted in the lab. Currently one of our members, Mr. Mohd Fadzil is already working with Dr. Yupiter in the simulation of laser welding on aluminum sheet.

Visitor 2

On 7th of June 2016, Dr. Jonathan from University of Lincoln, UK visited the School of Mechanical Engineering USM to discuss for future collaboration in the area of metal forming. The discussion begins with presentation from both parties. The Metal Forming Research Laboratory was represented by Assoc. Prof. Ir. Dr. Ahmad Baharuddin, the group coordinator. The meeting ends with laboratory visit to see our facilities. Few other members also presented in the meeting and visit.

Research Summary 1

Name: Mohd Nor Hakim Bin Hassan (PhD)
Title: Study on the Development of Ceramic Cutting Tool (Zta / Zta-Mgo) and its Machining Performance

Nowadays, many works have been done to develop cutting tool for optimal machining. One of the problems that need to overcome in achieving optimal performance is tool wear. Among many materials, Alumina (Al2O3) ceramics have been widely used in producing ceramic insert cutting tool. Besides the improvement of toughness by adding yttria stabilized zirconia (YSZ) into the Al2O3 that produced zirconia toughened alumina (ZTA), adding the nano particle of magnesium oxide (MgO) will further improve the hardness of bulk Al2O3. This work will focus to examine the performance of a new material develop as an insert for turning operation. The new material develops by addition of zirconia into the alumina matrix (ZTA) and reinforced by the right amount of magnesium oxide nano particle (MgO). Due to its enhanced toughness, the likely to experience fracture of failure when machining is reduced. Wear resistance of ZTA+MgO shows very low wear area thus making it very high wear resistance. The performances of these cutting insert in turning of hardened steel will be investigated. Cutting tools performances will be evaluated according to flank wear of the tool and surface finish of the workpiece.

Research Summary 2

Name: Norazlin Binti Md Yusop (MSc)
Title: Optimization of Tool Geometries in AA6061 Aluminium Alloy Deep Drawing for Reduced Risk of Thinning and Wrinkling

Deep drawing is one of the most important sheet metal forming processes and widely used in various industries such as automotive and aerospace. Deep drawing is a process of converting a sheet of blank at certain thickness into certain shape of geometry according to the die profile. Defects such as thinning and wrinkling is commonly being found in deep drawn parts due to many process and design parameters effect. In this research, a Finite Element (FE) model is developed for the 3-D deep drawing process using ANSYS Explicit Dynamics. The material studied is AA6061. The develop model is expected to predict the thickness distribution and thinning pattern of the blank prior to the die and punch design parameters changes such as punch and die shoulder radius, punch and die corner radius and few more. Optimal parameters will be then determined using statistical tool and validated using experimental.

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HYBRID MANUFACTURING – CURRENT STATE

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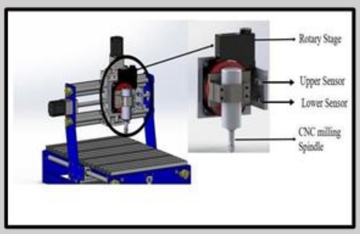
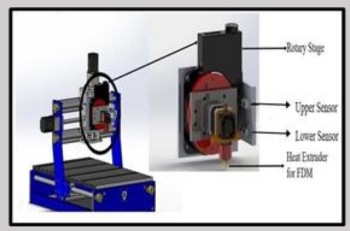
Technology-based classification method can be divided into five categorizes, namely joining for example welding process, dividing for example sawing process, subtractive for example machining process, transformative for example forming process and additive technologies for example rapid prototyping process (Nassehi et al. 2011). Combination of any two of these categories is consider as hybrid manufacturing and any two of these processes is consider as hybrid processes. While another terminology hybrid machine can be described as a machine that equipped with facilities that can perform at least any two of the above categories. In other work, Lauwers et al., (2015) classified hybrid process into two, which is the most common definition i.e. combination of different energy source or tools and controlled application of process mechanisms. The first category can be further separated into two, namely assisted processes and mixed processes. Example of assisted processes and mixed processes is laser assisted bending and EDM + grinding respectively. While example of controlled application is forming-hardening, where the hardening is controlled done during forming of the part, which is usually called as hot stamping process. One of main advantage of hybrid machine is less space and requires less programming (Sinkora, 2017). Another advantage of hybrid machine is it can reduce positioning errors and time wastage caused by re-fixing items (Lee et a., 2014). Hybrid manufacturing has huge potential for growth in terms of producing more complex parts with more flexibility and maintaining high accuracy in a relatively short production time. Hybrid processes open new avenues of research for enhancing processes capabilities, minimising their weaknesses and extending application areas. In addition, hybrid processes typically aim to achieve higher performance, in terms of material removal rate (MRR), surface integrity and tool wear (Zhu et al., 2013; Ichikawa and Natsu, 2013; Wei et al., 2010; Bulla et al., 2012, Attia et al., 2012). Zhu et al., (2014) introduced a machine that can performed three categories, which are additive, subtractive and inspection to address three most important factors, namely, tool accessibility, production time and dimensional accuracy. Other benefit of hybrid manufacturing is reduction of force (Heisel et al., 2008), excellent surface finish (Vanparys, 2012; Lauwers, 2010) and

Recently Developed Hybrid Machine

The most common hybrid machine available in the market is a machine with combination of subtractive manufacturing method such as machining and additive manufacturing such as 3D printing technology. One of the developed hybrid machine as shown in Figure 1(a) and (b) Amanullah et al., (2016). The machine owns an interchangeable attachment where CNC spindle and extruder can be attached to. Rotary stage, upper and lower sensors were included for alignment purposes.



(a)



(b)

Figure 1: Hybrid machine with (a) CNC milling spindle; (b) FDM extruder

Other similar machine that combine CNC machining and FDM operation can be seen in Figure 2 (Lee et al., 2014). Both are attached on a single platform. The developed prototype of the hybrid machine is as shown in Figure 3.

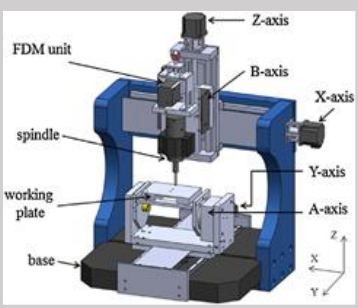


Figure 2: The design of the hybrid FDM and five-axis machine tool.

Figure 3: The prototype of hybrid FDM and five-axis machine tool.

There are many more examples that similar to this machine (Muller and Wings, 2016) and as reviewed by Zhu et al., (2013) that produce small part only, while for medium and bigger size part seem to be overlooked by researcher.

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