

<<第16届国际电加工会议论文集>>

图书基本信息

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前言

The International Symposium on Electromachining (ISEM) is a triennial meeting of academia and industry that specializes in electro-physical and electro-chemical machining. This event is conducted under the auspices of the International Academy for Production Engineering (previously known as International Institution for Production Engineering Research and also CIRP, from the French name Collige International pour la Recherche en Productique'). It serves as a platform for the dissemination of the latest scientific and technological accomplishments that represent the state-of-the-art in nontraditional machining processes. The ever increasing diversity of the geographical locations of participants and the wide spectrum of topics covered since the beginning of ISEM in 1960's is a testimony of the growing success and popularity of this international symposium. The 16th International Symposium on Electromachining (ISEM XVI) is held in Shanghai China, just 11 days before the World EXPO 2010. Situated in the Yangtze River Delta on China's eastern coast, Shanghai is renowned as the most internationalized metropolitan city in China. Shanghai has given the birth to China's modern industry, and witnessed the great changes in China's modern history. Over thirty years of economic reform, Shanghai has metamorphosed into an economic power house in China. The city as a whole is on the way towards an international center for finance, logistics and transformation which is expected to be accomplished by the year 2020.

内容概要

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章节摘录

插图：The EDM process has been used in industry for decades, and it is, by far, the most common amongst the non-conventional machining processes. Its applications cover a variety of industries such as mould and tool making, automotive medical and micromechanics. In spite of the mentioned popularity of this process, its use has been largely based on empirical knowledge and on the experience of EDM machine users. As a result, accurate predictions of material removal rate, surface finish and surface integrity have only been achieved after costly trial-error approaches. The existing lack of scientific knowledge can be attributed to two main reasons: First, there exist great difficulties when it comes to experimentally measuring magnitudes related to the discharge process; second, EDM involves several physical phenomena, including thermal, electrical, mechanical and metallurgical processes. Determining the complex relationships amongst parameters is a difficult task, and makes modelling of EDM a challenge. In recent years, efforts have been put on modelling of the process, both numerical and analytical. As said before, during the discharge process effects of very distinct nature merge together, but it is commonly accepted that the thermal effect is the most important of them, being other aspects such as the electrical forces less significant when it comes to the material removal mechanism. This is why thermal modelling of EDM is one promising alternative, since a deep knowledge of the mechanisms involved in this process can be acquired. If the discharge channel formed during erosion, together with the material ejection are adequately represented by a thermal model, it will be possible to make predictions of the material removal rate, surface finish and surface integrity, but it is at this point when difficulties concerning the experimental characterization of the discharge process arise. The dispersion found in published models suggests that more research has to be carried out on this field. No doubt, the validity of thermal modelling tool relies on the similarity between the modelled heat source and the actual discharge process. In this sense, special care has to be taken when defining the heat input, and also when determining the discharge location criteria. In literature, two approaches to simulation can be found, one is centred in solving the thermal problem associated to the erosion caused by a single discharge [1-81], and the other is focussed on the discharge location algorithm, as a tool for predicting the shape of both workpiece and electrode after an EDM operation. The main drawbacks concerning thermal simulation of single discharges are related to the fact that process conditions when carrying out single discharge experiments differ substantially from those occurring during continuous EDM. Three are the arguments to consider that those situations have relevant differences. The first of them is that single discharge experiments are performed on workpieces whose surfaces do not show the roughness profiles characteristic of EDM-ed surfaces. The absence of those irregularities may have effect on the discharge process as well as on the material removal mechanism. The second reason is the presence of gas bubbles in the interelectrode gap. Some researches reveal that a big percentage of the gap volume is filled with bubbles after the first instants of erosion, and that discharges developed in a gaseous medium differ from those that take place in liquid dielectric. And finally, the third argument to consider is the effect that the debris generated during erosion has on the process. This debris reduces the insulating properties of the dielectric medium and therefore influences the discharge generation mechanism and location. It also increases the gap width, which affects the geometrical precision of the manufactured pieces. On the other hand, those models focussed on the evolution of the geometries of both workpiece and electrode during EDM operations, through simulation of discharge location algorithms give useful information about process features at macroscopic scale, but cannot deal with the generation of surface roughness profiles, nor with the thermally induced damages, such as white layer formation, heat affected zones, residual stresses or microcrack formation. As previously mentioned, when developing a thermal model of EDM, the definition of discharge characteristics must be as realistic as possible, in order to obtain results that can reflect the process outputs accurately. These characteristics can be summarized in three parameters: the amount of energy involved in the heating of the workpiece material, growth law and size of the plasma channel, and the material ejection mechanism.

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