Industry 4.0

Industry 4.0 is based on the technological concepts of cyber-physical systems, Internet of Things and Internet of Services. It facilitates and contributes to the vision of Smart Factories. Within the modular structured smart factories of Industry 4.0, cyber-physical systems are in fact cyber-physical production systems that monitor physical processes, create a virtual copy of the physical world and make decisions autonomously. Over the Internet of Things, cyber-physical production systems communicate and cooperate with each other and humans in real time. Via the Internet of Services, both internal and cross-organizational services are offered and utilized by participants of the value chain.

Energy-efficient machining

Increased energy prices, severe environmental pollution issues and global warming make manufacturers pay more attention to achieve energy-efficient machining. With Industry 4.0, it can be regarded as a kind of integrated technology which covers the major aspects in production, such as manufacturing method, design, monitor technology, etc. Although energy demand is generated during machining processes, the design of a part also influences the corresponding energy consumption. In this research, both of the two aspects above are considered. For design, its major purpose is to meet the corresponding function and requirement, and relevant software such as UG, Creo, Solidworks, etc. are the popular tool nowadays. Besides, STEP standard, such as AP203, AP214 and lately AP242, are widely used in design phase to describe a workpiece, which provides a part digital model. STEP-NC is feature-based, but AP203 and AP214 are not. Therefore, feature recognition is utilized to connect the design and process planning. During this process, some contributing factors to energy demand are considered, such as geometry size, position of a feature, parameter, strategy, cutter, machine tool, tool approach direction. When the STEP-NC file is output, its energy consumption can be calculated through the energy assessment with the support of the above factors. Consequently, the energy demand of a part at design phase is realized, which is a reference for users to revise the design. Besides, the different design may lead to distinct optimized scheme in machining.

Main Contributions

- Approach to integration of design and process planning
- Feature recognition using ontology approach
- Energy consumption model based on STEP-NC
- Energy-efficiency assessment method
- Analysis of major contributing factors to energy demand