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A Knowledge Platform for Surface Texture in Advanced Manufacturing

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Abstract: The trend in global manufacturing requires a knowledge driven economic environment with digital planning and communication to obtain significant time and cost saving. It has pushed the geometrical product specifications (GPS) system into a rigorous mathematical framework with great potential to save production time and cost. However as yet it is largely a document based system with a great number of geometrical documents and its implementation is viewed as highly complex, requiring high levels of understanding. One of the particular examples is surface texture, an essential and one of the most complicated geometrical specification and verification systems in GPS. It is relevant for the whole surface manufacture chain from design through manufacture and qualification, and plays a significant role in determining the function performances of a workpiece. In recent years, the characterisation of surface texture has been through a paradigm shift from profile to areal analysis. Surface design, manufacturing and metrology are however incoherent, become a very complicated and ambiguous system, especially with the necessary skills/expertise are often not available in manufacturing. To address this issue rigorous knowledge representation methodology is a necessary support tools for surface texture in design, manufacture and measurement.

A knowledge platform for surface texture design, manufacture and measurement is designed and developed in the paper. A category theory based knowledge acquisition and representation mechanism to retrieve and organize knowledge from various GPS documents has been devised. Deploying this methodology, the knowledge modelling for areal and profile surface texture is carried out. The design and implementation of the platform is developed based on the modelling. The system is constructed with two modules (for profile and areal surface texture) each with five components. A special module is developed for a global manufacturing company with a single roughness parameter *Ra* for the customised surfaces. An XML and Component Object Model (COM) based interface technology has been utilised for integrating the platform into a computer-aided framework, such as AutoCAD and SolidWorks.

Significance Statement: The Significance of this work is to facilitate engineers using updated GPS standards to design, manufacture and measure the surface texture for fast, flexible and cost saving manufacturing, by creating an integrated surface texture knowledge platform.
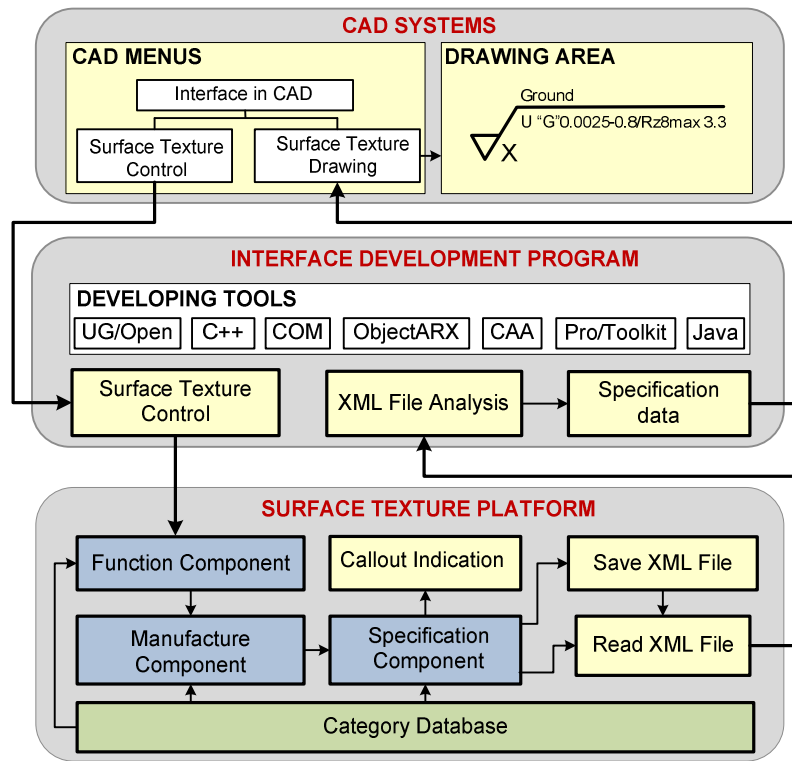
Figure 1. The architecture of the integrated surface texture knowledge platform