DIGITISATION OF SKILL-INTENSIVE MANUFACTURING PROCESSES

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ABSTRACT

This talk will focus on the development and application of novel digitisation techniques for smart industrial systems. The research on digitisation of skill-intensive manufacturing processes is based on the concept that every manual manufacturing task is an interaction between the human worker and the workpiece(s). In this interaction, every human action step on the workpiece is followed by feedback from the workpiece to which the worker reacts in the next step. This feedback could be visual, audible and/or tactile. A series of such action-feedback-reaction loops results in the workpiece being processed from start to finish. By observing these interactions and capturing human actions and their effects on the workpiece over the duration of the task and for multiple runs of that task, expert human gestures in executing the task and adept human responses to unexpected problems in the task, can be extracted and digitised. Now the availability of human motion data and the ability to acquire the depth perception to track changes to the workpiece (size, orientation, features) simultaneously makes it possible to capture human-workpiece interactions on a shopfloor in an inexpensive manner.

The simultaneous tracking of human actions and the effect of those actions on the workpiece(s) during a skill-intensive manual task and the digitisation of this real-time knowledge will be demonstrated in this talk using a gaming interface technology Microsoft KinectTM. The main steps in this research are the spatio-temporal segmentation of the captured continuous digital data into human and workpiece states and the subsequent human-workpiece state interaction modelling. These steps enable deeper investigation of manual tasks, decoding of associated human skills and eventually the prediction of human actions in response to given task scenarios, paving the way for intelligent automation of skill-intensive manual manufacturing tasks. As an example of this research, an Innovate UK project with Jaguar Land Rover and Holovis International developed a platform for geographically distributed manufacturing sites to collaborate in real-time. Another example is collaboration with GE and Lanner Group on an EPSRC project that has

digitised real-life manufacturing processes for live feedback to manufacturing simulations.

In the near term, digitised knowledge of human postures and actions during manual manufacturing operations can be studied to assess the ergonomics and productivity of such operations and to redesign workstations. In the medium term, skills acquired and digitised from experienced craftsmen can be effectively transferred to apprentices via skill demonstrations in virtual workstations, minimising the need for long apprenticeships. In the long term, human skill models generated by capturing and modelling human-workpiece interactions from complex manufacturing tasks could provide the intelligence behind successful automation of such tasks