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Author: Mr. Yun-Hang Cho
University of Sheffield, United Kingdom, yun-hang.cho@sheffield.ac.uk

DESIGN OF ROBOTIC ARMS WITH SMART END-EFFECTORS FOR IN-ORBIT ASSEMBLY AND DIS-ASSEMBLY

Abstract

Much effort often goes into making industrial robotic arms certified for space operation. Examples include changing the lubricant, cold welding and other thermal/vacuum considerations. However, less effort is focused on developing and designing innovative compatible end-effectors/fastener systems for in-orbit assembly and disassembly of components (exceptions exist). If the in-orbit manufacturing dream is going to be realised, in-orbit handling of components must be developed much more beyond the current state. How can an end-effector simultaneously hold onto a space component whilst unfastening it?

In the context of the growing space debris issue, creating further debris from an assembly mishap would have disastrous consequences not only for that particular satellite operator but everyone else sharing the same orbit.

If the control of the robotic arm is not accurate enough, are existing fasteners such as small bolts still suitable? How does the use of larger fasteners affect the mass budget?

The use of smart end-effectors to increase the accuracy and capabilities of a robotic arm system is not unique to the space sector. The manufacture of components (on Earth) using robotic arms faces similar challenges as serially linked robotic arms with longer lever arms are naturally more unstable and inaccurate to CNC machines. This is an area of expertise at the Integrated Manufacturing Group at the Advanced Manufacturing Research Centre.

This paper will review the existing innovative catalogue of smart space end-effectors for fastening (and un-fastening) components. In doing so, it will identify some of the common challenges that they face. Finally, the use of different innovative sensors and control systems will be discussed to suggest how some of these challenges could be resolved using more sensorised smarter end-effectors driven by self-learning control systems.