Development of a Modular End Effector for the installation of Curtain Walls with cable-robots

Abstract:
The installation of façade enclosures is a manual, dangerous, and time-consuming construction task. However, thanks to the capability of automated systems, the application of automation in construction is increasing, and therefore, manual work and risky situations can be avoided. Despite this, only a few robotic systems are capable of spanning such a vast work space, i.e. the façade of a building. Among these systems is the cable driven parallel robot (CDPR). Furthermore, the CDPR could carry heavy loads such as unitised curtain wall modules (CWM). Nevertheless, the tools and devices required for installing the CWM need to be innovated. Firstly, in order to cover that research gap, the current manual procedure was analysed in detail. After that, the development team evaluated several options for performing the tasks. Finally, an optimal solution was chosen: the so-called modular end-effector (MEE). The MEE comprises several tools in order to achieve various tasks. Mainly, these tasks are: drilling the concrete slab, bracket installation, and CWM handling and positioning. In addition to the aforementioned tasks, the MEE should
accurately fix all elements with a desired tolerance less than 1 mm. Meanwhile, the MEE should compensate for the perturbation movement due to external forces such as wind that affect the system. As part of the study, a detailed workflow for the automated installation of CWMs was elaborated. The drilling step of the workflow was tested and the result is presented in this paper.

**Stichworte:**
Modular end effector; Cable robot; Construction robotics.

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