Human-Robot Co-adaptation in Construction: Bio-signal based Control of Bricklaying Robots

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ABSTRACT

Robots will soon become as commonplace as heavy-duty vehicles at construction sites. Their emergence will create safety challenges, as most of them will work very near humans in the dynamic and unstructured workplace of construction. Among them, being stuck by robots could be a major cause of accidents. Robotic control techniques can tackle these challenges by providing efficient and reliable channels for worker-robot interaction. However, traditional techniques, such as haptic- and gesture-based control, require workers to use hands and arms as middleware. Therefore, in scenarios where workers' range of motion is restricted – such as moving materials or roofing – physically interactive control may not be adequate. To bridge the gap, this study examines the feasibility of a novel approach. The technique employs an adaptive neural network to translate workers' mental images of their bodily movements into robotic commands via brainwave signals. These commands regulate robots' actions through human kinematics. To examine its performance, four subjects were instructed to control a masonry robot lifting and placing concrete bricks to build a wall. The results demonstrated that the average success rate of picking up and laying bricks was 84.02%, with a 3.35% standard deviation. This demonstrates the feasibility of controlling robots under the physically complex conditions of construction sites. It opens the door to safer interaction between workers and construction robots.