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Mathematical Description of Functional Motion and Application as a Feeding Mode for General Purpose Assistive Robots

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Abstract : Eating a meal is among the Activities of Daily Living, but it takes a lot of time and effort for people with physical or functional limitations. Dedicated technologies are cumbersome and not portable, while general-purpose assistive robots such as wheelchair-based manipulators are too hard to control for elaborate continuous motion like eating. Eating with such devices has not previously been automated, since there existed no description of a feeding motion for uncontrolled environments. In this paper, we introduce a feeding mode for assistive manipulators, including a mathematical description of trajectories for motions that are difficult to perform manually such as gathering and scooping food at a defined/desired pace. We implement these trajectories in a sequence of movements for a semi-automated feeding mode which can be controlled with a very simple 3-button interface, allowing the user to have control over the feeding pace. Finally, we demonstrate the feeding mode with a JACO robotic arm and compare the eating speed, measured in bites per minute of three eating methods: a healthy person eating unaided, a person with upper limb limitations or disability using JACO with manual control, and a person with limitations using JACO with the feeding mode. We found that the feeding mode allows eating about 5 bites per minute, which should be sufficient to eat a meal under 30min.

Keywords : assistive robotics, automated feeding, elderly care, trajectory design, human-robot interaction
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