This dissertation addresses the problem of improving the ability of a wheelchair mounted robotic arm to help a disabled user in the performance of activities of daily living (ADLs). ADLs usually require the manipulation of objects in various locations in the user’s home. Our goal is to enable the autonomous execution by the wheelchair / robotic arm assembly of a natural language command given by the user. This requires solving two subtasks: moving the wheelchair in such a way that the manipulator can conveniently grasp the object and the movement of the manipulator itself.

To address the challenge of finding the position appropriate for the required manipulation we introduce the ease-of-reach score ERS. ERS quantifies the preferences for the positioning of the base while taking into consideration the shape and position of the object to be grasped as well as clutter and obstacles in the environment. As the brute force computation of the ERS is computationally expensive, we propose a machine learning approach to estimate the ERS based on features and characteristics of the obstacles.

To address the problem of the robotic arm movement, we start from recent results in deep learning-based controllers that can learn to control vision-enabled robotic arms to manipulate objects from a moderate number of demonstrations. However, the current state of the art systems are limited in their robustness to physical and visual disturbances and do not generalize well to new objects. We introduce an attention-based technique that uses the natural language command of the user to focus the robot’s vision system on the object that currently needs to be manipulated. Our experiments show that our approach significantly improves the robustness of the manipulation and the performance in clutter.

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The public is welcome to attend.