

PATIENT-COOPERATIVE GAIT NEURO-REHABILITATION WITH THE LOWER-EXTREMITY EXOSKELETON ANDROS

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ABSTRACT

The Active Knee Rehabilitation Orthotic System (ANDROS) is a lower-extremity exoskeleton developed as an assistive tool for gait rehabilitation of patients recovering from neurological ailments such as stroke (Figure 1). The exoskeleton consists of two leg braces: The active brace applies corrective forces to the patient through its human-machine interface. These corrective forces are generated via the impedance-controller, based on the deviations from a reference trajectory.

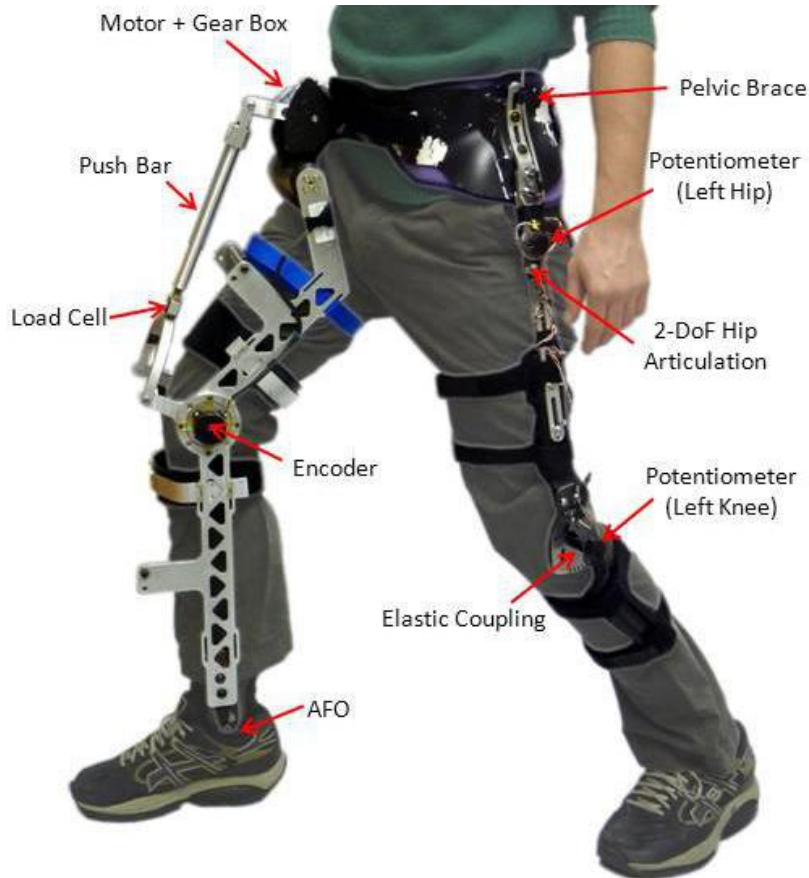


Figure 1: The lower extremity exoskeleton ANDROS is a wearable and portable assistive tool for gait re-habilitation and monitoring of people with motor control deficits due to a neurological ailment, such as stroke. ANDROS reinforces a desired gait pattern by continually applying a corrective torque around the knee joint, commanded by the impedance controller. A sensorized yet unactuated brace worn on the unimpaired leg is used to synchronize the playback of the desired trajectory based on the user's intent. The device is mechanically grounded through two AFOs rigidly attached to the main structure, which helps reduce the weight perceived by the user.

Training algorithms of rehabilitation robots are constantly evolving as we gain a more in-depth understanding of the mechanisms underlying motor recovery. One such understanding is the positive effect of kinematic variability on the outcomes of motor learning. In light of these recent findings, researchers are moving away from training patterns that are fixed in the spatiotemporal space, and more towards a “patient-in-charge” paradigm in which the patient influences the reference trajectory (Figure 2).

In this paper, we discuss a new “patient-cooperative” strategy implemented on ANDROS. In this new algorithm, the “ideal” reference trajectory for the impedance controller does not only synchronize with the patient in the temporal space, but also in the spatial space.

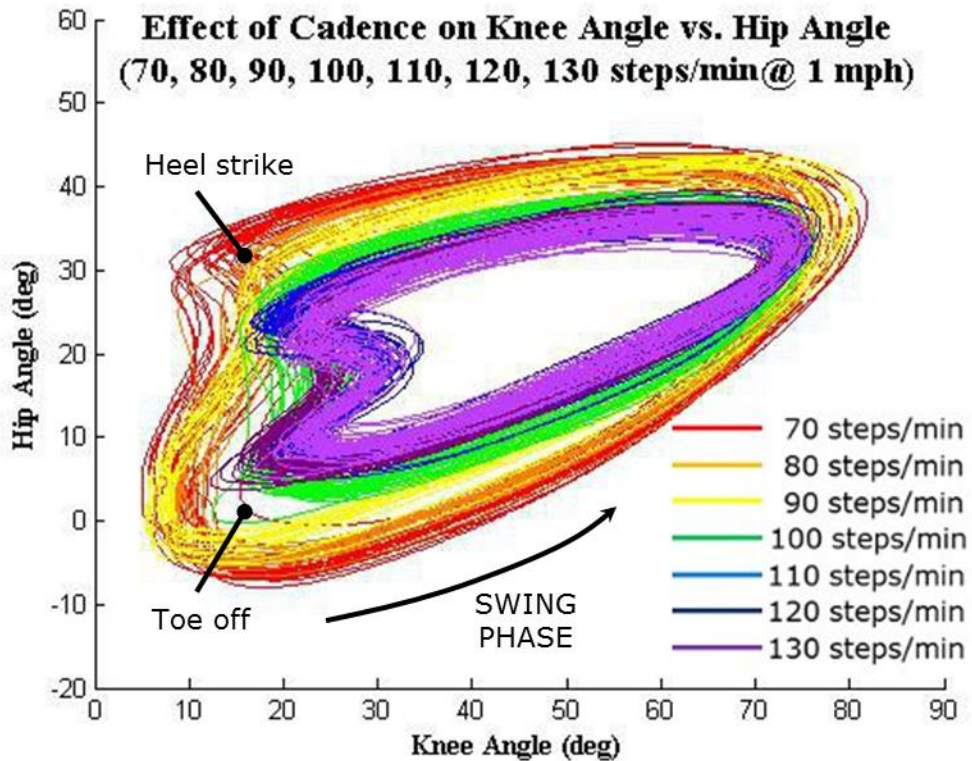


Figure 2: The effect of cadence on the kinematic parameters of gait. Our hypothesis is that the “ideal” reference trajectory for the impedance controller should not only adapt to the patient in the temporal space, but also in the spatial space.