J. Moreno, S. Güimil, J. Gonzáles-Quijano, J. Sánchez, J. Pons, Á. Gil. Design of a controllable wheelchair ergometer for simulation of real life conditions. Gerontechnology 2008; 7(2):167. Wheelchair ergometers are platforms that allow the simulation of wheelchair motion. A few instrumented and computer-controlled ergometers have being proposed in order to simulate the wheelchair propulsion, with preliminary evidence of clinical application[1]. Designs vary according to construction, level of adaptability, number/modes of simulation and sensor systems[2]. A proper method to calculate the applied 3D forces during propulsion is important to train new wheelchair users. We report the design of a novel controllable static wheelchair ergometer. The design consists of a wheelchair mounted on a support, with a high level of adjustability to users and testing conditions. The ergometer enables the realization of stationary exercises with a realistic simulation of different types of propulsion, in combination with the measurement of biomechanical and metabolic parameters. **Methods** With the goal of investigating the influences of variations in mechanical parameters in wheelchair users, the ergometer is conceived as a platform with adjustable positions (wheels, seat, and back rest) and sizes of wheel frames. The instrumentation consists of 3D force and torque transducers measuring three components of the forces and torques applied on the hand rims and also 3D force transducers applied on the seat and the backseat. Encoders are placed to measure the instantaneous velocity and acceleration of each wheel. Inertial sensors are fixed on the wheelchairs frame to calculate tilt, based on accelerometer data. The force/power exerted by the user in order to accelerate the wheels is calculated based also on the force transducers. Actuation is provided by motors controlled by a master computer with a data-acquisition system for all incoming signals. Two motors of 250 W are used with and effective output torque at each of 30 N.m. The acquisition system enables capturing of additional systems, e.g. electromyography (EMG), pressure socket, heart rate, etc. A software application in the master computer is developed for control and measurement purposes. The control system is designed in order to simulate for rolling resistance, air drag and slopes, controlling the wheels. A maximum velocity of 10 m/s is considered. The simulated propulsion might be isokinetic, isoinertial or static. The overall inertia of the human-machine system will also be simulated. A biofeedback monitor is presented to the user to control performance and effort. Also, different types of floor textures can be simulated. **Results and discussion** A novel design of a wheelchair ergometer is presented. The minimised set of transducers integrated in the structure allows for the quantification of the most relevant kinesiological parameters, in a relatively low cost solution. The control system permits the simulation of the varying conditions of propulsion at the wheels, adjusting the inputs to the motors. The remote master computer implements the real-time monitoring and control applications. A preliminary study with manual wheelchair users in combination with a marker-based 3D motion analysis system will be the next step in order to examine the strategies adopted by the users for each simulated condition.

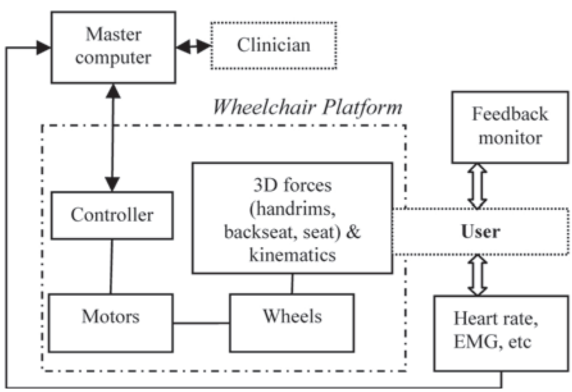

Figure 1 Configuration of the system

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