



**Politecnico
di Torino**

ScuDo

Scuola di Dottorato ~ Doctoral School

WHAT YOU ARE, TAKES YOU FAR

Doctoral Dissertation
Doctoral Program in Mechanical Engineering (34th Cycle)

Design, prototype and experimental validation of innovative manual wheelchairs for everyday life and sport

By

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Declaration

I hereby declare that the contents and organization of this dissertation constitute my own original work and does not compromise in any way the rights of third parties, including those relating to the security of personal data.

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* This dissertation is presented in partial fulfillment of the requirements for **Ph.D. degree** in the Graduate School of Politecnico di Torino (ScuDo).

Abstract

The thesis concerns the complete develop, from the concept to the experimental test, of manual wheelchairs both for everyday and sport use with an innovative system of propulsion. Starting from the state of the art, an innovative system of propulsion has been developed to solve some critical aspects about the standard system of propulsion as to increase of the efficiency, to reduce the pain on the upper limb and to increase the mobility and the independence of the users. The functional and the executive design have been developed for both the wheelchair for everyday life, Handwheelchair.q, and sport, Handwheelchair.q racing. Then, in the prototyping phase, the functionality of each subsystem has been verified and optimised. In 2019, we started a collaboration with the doctors, physiatrists and physiotherapists of the U.S.U. (Unità Spinale Unipolare) in Turin, in order to conduct the experimental activity with spinal cord injury patients. The pandemic has interrupted the collaboration. The test have been conducted on able-bodied subjects with the main goal to define the methodology and the experimental apparatus to test the innovative wheelchair. Different tests have been conducted: test to analyse the efficiency of the prototype from a mechanical point of view, test to analyse the force of the user applied on the wheelchair in different condition of external load, test to evaluate the prototype in different configurations, test to compare the standard and innovative wheelchair from electromyography activities.

