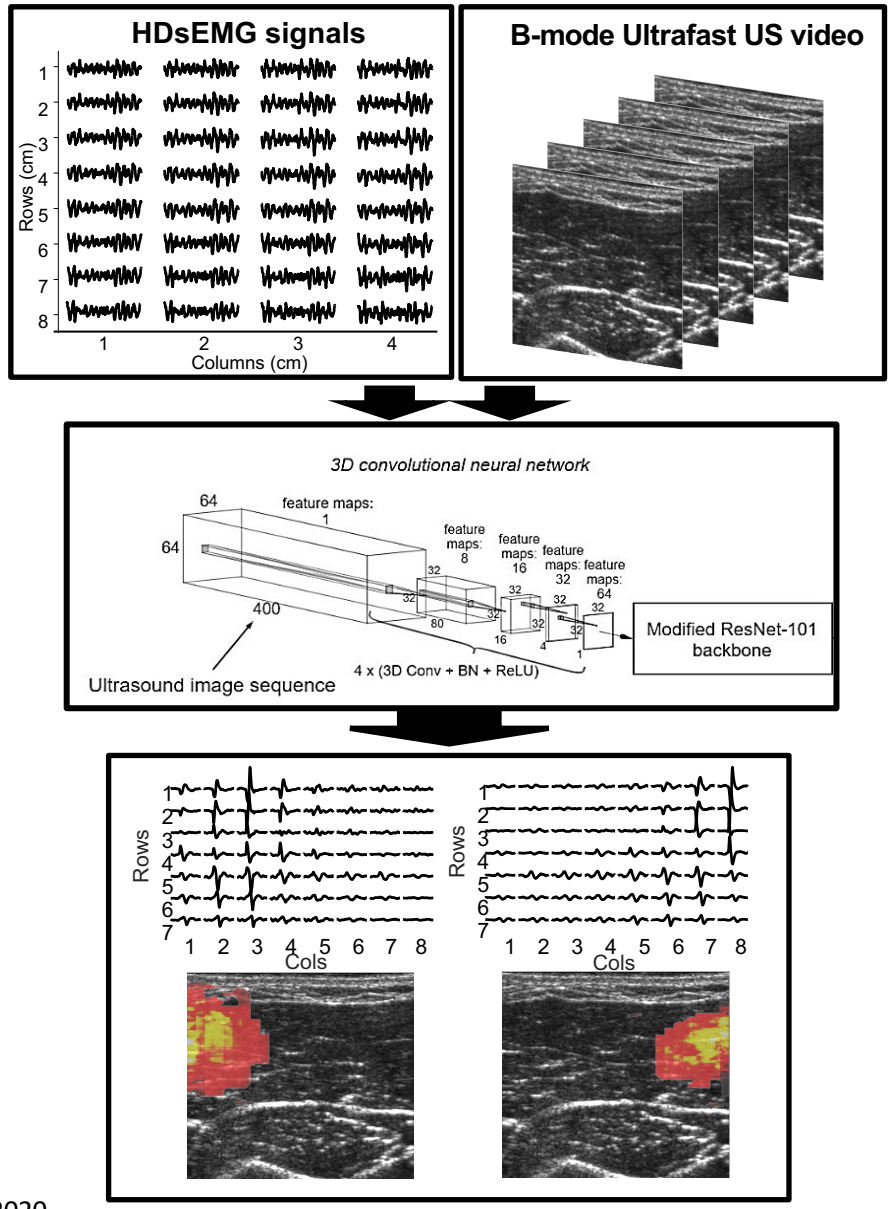
Identification of MU in Musculoskeletal Ultrasound: a deep learning approach

Rationale

The in-vivo assessment of motor unit (MU) function is relevant in several research and clinical areas, from the diagnosis of neuromuscular diseases, to neurorehabilitation and sport sciences. High density surface electromyography (HDsEMG) decomposition is typically used to identify the firing instants and the electrical properties of single MUs. By combining HDsEMG with Ultrafast Ultrasound (UUS) imaging, we recently demonstrated the possibility to integrate this electrophysiological characterization with the physical (anatomical and mechanical) MU properties, in order to obtain an electromechanical description of MU function [1]. In this context, the use of deep learning pipelines for the analysis of UUS images [2] may improve the accuracy in MU territory identification within the muscle cross-section, and therefore the extraction of electrical and mechanical properties of single MUs.

Methods

The aim of this thesis is to investigate the possibility of applying deep learning methodologies to identify individual MUs in spatio-temporal data of contracting muscles. The development of a method will be performed on simulated electro-mechanical data (HDsEMG + UUS) of muscle contractions and finally tested in vivo on experimental data.



[1] Carbonaro M, Meiburger KM, Seoni S, Hodson-Tole E, Viera T, Botter A. *Physical and electrophysiological motor unit characteristics are revealed with simultaneous high-density electromyography and ultrafast ultrasound imaging.* Sci Rep 2022

[2] Hazrat A, Rohlén R, Grönlund C. A Deep Learning Pipeline for Identification of Motor Units in Musculoskeletal Ultrasound. IEEE Access 2020