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CONGRESO INTERNACIONAL DUCHENNE
PARENT PROJECT ESPAÑA

3 SALUD Y BIENESTAR
4 EDUCACIÓN DE CALIDAD
7 ENERGÍA ASEQUIBLE Y NO CONTAMINANTE
17 ALIANZAS PARA LOGRAR LOS OBJETIVOS

Duchenne PARENT PROJECT España

UNIVERSITAT DE BARCELONA
Càtedra de Malalties Rares

ArmTracker project

A state-of-the-art wearable system to assess upper limb motor function in real-life conditions for patients with Duchenne muscular distrophy (DMD) and spinal muscular atrophy (SMA)

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MOTIVATION

Recent advances in **gene therapy** are opening a new era for children with Duchenne Muscular Dystrophy (DMD) and Spinal Muscular Atrophy (SMA).

However, in spite of this impressive progress, the **motor functional scales** traditionally used are not fully adequate to evaluate the efficacy of these new treatments as they are performed in an artificial environment, in an intermittent way and tend to be influenced by external factors.

There is a need for a new wearable system adapted to patients with DMD and SMA to **continuously** monitor their upper limb activity **in real-life conditions**, sensitive enough to detect small changes on the motor function that traditional methods fail to detect.
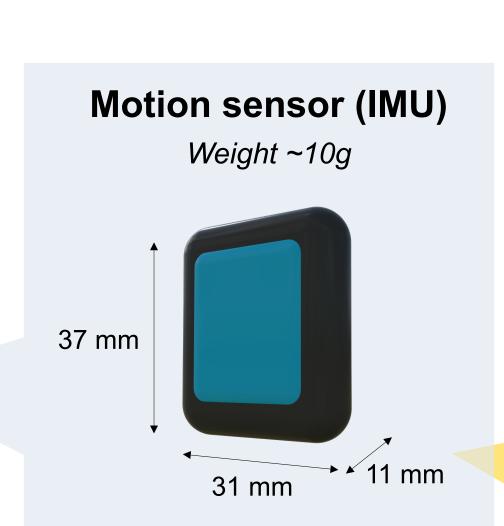
The data collected could be used to define a new family of **digital biomarkers**. The clinicians will implement these digital biomarkers to continuously improve the result of the therapy.

OUR SOLUTION

The **ArmTracker** consists in a set of small and lightweight wireless motion sensors placed on the upper body to track the upper limb movement during daily activity.
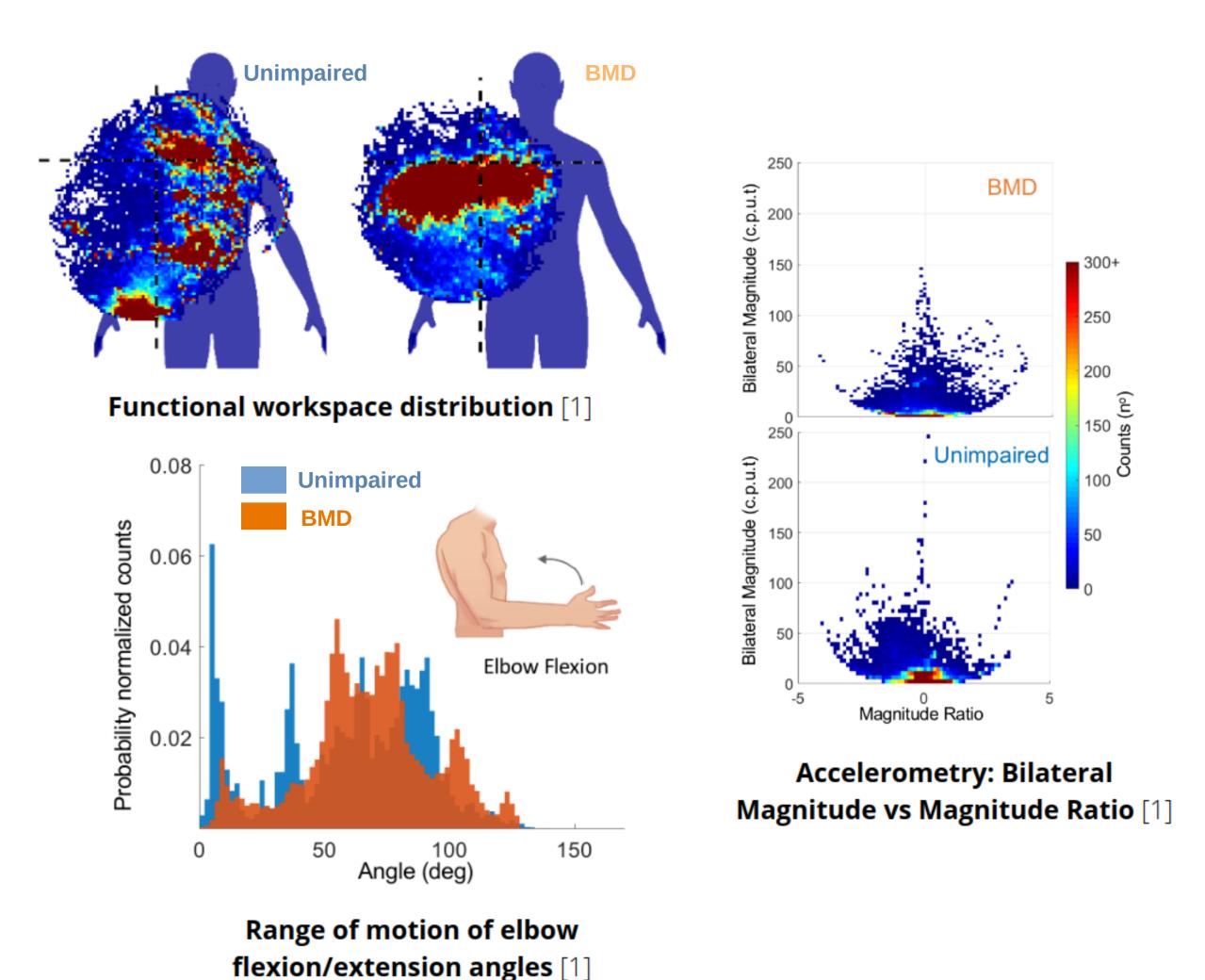
Using the data collected with those sensors, we create a **kinematic model** of the upper limbs. Several types of metrics are computed to analyze the quantity and quality of the upper limb movements, such as **joint range of motion**, **functional workspace distribution** and **accelerometry**, among others.

Preliminary tests have been performed with a prototype in healthy subjects and subjects with Becker Muscular Distrophy (BMD) to validate the feasibility of the solution [1].

Motion sensor (IMU)
Weight ~10g

37 mm
31 mm
11 mm

The wearables are attached using a T-shirt or velcro straps to provide **maximum comfort** and avoid movement constraints The sensors can continuously record motion data during **7h per day** and transfer it overnight to a computer or smartphone.

Functional workspace distribution [1]
Unimpaired / BMD

Accelerometry: Bilateral Magnitude vs Magnitude Ratio [1]
BMD / Unimpaired

Range of motion of elbow flexion/extension angles [1]
Unimpaired / BMD / Elbow Flexion
Probability normalized counts / Angle (deg)

The signals are analyzed and segmented applying **machine learning** methods to:
- distinguish voluntary arm movement from external disturbances
- classify voluntary movement into intensity levels
- identify types of activities of daily living

[1] V. A. Carmona-Ortiz, J. Lobo-Prat, J. Van Ruysevelt, C. Torras and J. M. Font-Llagunes, "Development and Pilot Evaluation of the ArmTracker: A Wearable System to Monitor Arm Kinematics During Daily Life," 2020 8th IEEE RAS/EMBS International Conference for Biomedical Robotics and Biomechatronics (BioRob), 2020, pp. 759-764,

METHODS

A **pilot study** (n=15) will be performed at Hospital Sant Joan de Déu (Barcelona) by the end of 2022 to assess the safety and usability of this solution, as well as to analyse the correlations between clinical data, traditional motor function scales and the ArmTracker measurements.

The solution will be first tested on **non-ambulant children** for whom the correct functionality of the upper limbs is an essential condition for their autonomy and quality of life.

EXPECTED RESULTS

The ArmTracker is expected to offer relevant and pertinent clinical variables to assess non-ambulant DMD and SMA patients, enabling clinicians to better monitor the disease progression and treatment efficacy in a continuous way.

The ultimate goal is to define a relevant biomarker that could be used to guide therapy decisions in this new context of **personalised medicine** and as **clinical endpoin**t in clinical trials.