

# Towards Fes - Assisted Grasping Controlled by Residual Muscle Contraction and Movement on Persons with Tetraplegia

Wafa Tigra, Lucas Fonseca, Benjamin Navarro, David Guiraud, Antonio Padilha Lanari Bo, Emerson Fachin-Martins, Violaine Leynaert, Anthony Gélis, Christine Azevedo Coste

► **To cite this version:**

Wafa Tigra, Lucas Fonseca, Benjamin Navarro, David Guiraud, Antonio Padilha Lanari Bo, et al.. Towards Fes - Assisted Grasping Controlled by Residual Muscle Contraction and Movement on Persons with Tetraplegia. ISPRM: International Society of Physical and Rehabilitation Medicine, Jul 2018, Paris, France. 12th International Society of Physical and Rehabilitation Medicine World Congress, 2018. lirmm-01849237

**HAL Id: lirmm-01849237**

**<https://hal-lirmm.ccsd.cnrs.fr/lirmm-01849237>**

Submitted on 25 Jul 2018

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# TOWARDS FES-ASSISTED GRASPING CONTROLLED BY RESIDUAL MUSCLE CONTRACTION AND MOVEMENT ON PERSONS WITH TETRAPLEGIA

W. Tigrá<sup>1</sup>, F. Lucas<sup>2</sup>, N. Benjamin<sup>3</sup>, G. David<sup>1</sup>, P. Antonio<sup>2</sup>, F. Emerson<sup>4</sup>, L. Violaine<sup>5</sup>, G. Anthony<sup>5</sup>, C. Azevedo Coste<sup>1</sup>.

<sup>1</sup>inria / lirmm, camin, Montpellier cedex 5, France.

<sup>2</sup>Brasilia University, lara, Brasilia, Brazil.

<sup>3</sup>LIRMM - University Montpellier, idh, Montpellier, France.

<sup>4</sup>Brasilia University, ntaai, Brasilia, Brazil.

<sup>5</sup>Centre de Rééducation Fonctionnelle Neurologique Propara, Union Mutualiste Propara, Montpellier, France.

## **Introduction/Background**

Functional electrical stimulation (FES) can be used on individuals with upper motoneuron dysfunctions to restore grasping functions. To be functional and useful in daily tasks, the patient must be able to pilot the device by means of an interface. We have investigated two techniques that could address the situation of persons with tetraplegia: electromyography (EMG) and inertial measurement units (IMU), respectively measuring muscle activity and limb movements.

## **Material and Method**

One group of 8 tetraplegic patients (EMG group) was equipped with two pairs of EMG electrodes located on muscles of the upper arm. Selected muscles could be voluntarily activated in a comfortable way. Another group of 9 tetraplegic patients (IMU group) was equipped with one IMU (3-axis accelerometer and 3-axis gyroscope) located on the arm. In the EMG group a threshold detection algorithm was used to detect muscle contractions while in IMU group a classification algorithm was used to detect two distinct movements of the limb where the IMU was located. The detection algorithms outputs were used to trigger two postures of a robot hand. The same outputs were also used, for patients where FES of arm muscles lead to visible hand movements, to trigger the contractions of two muscles on their contralateral lower arm.

## **Results**

All the patients were able to control muscle contraction or limb movements to trigger different actions. Patients were asked to control the robotic hand, following a randomized sequence of two pre-defined postures. In EMG group the success score was of 95% and 92% in IMU group. Whenever FES was used, patients could activate grasping movements and wrist extension. Three patients were able to perform functional tasks such as grasping and relocating objects.

## **Conclusion**

Despite little training, all the patients were able to voluntarily control a robotic hand and, when it was possible to test, their own hand with FES.

## **Keywords:**

Movement analysis  
Electromyography interface  
Inertial Measurement Unit interface