TELE-REHABILITATION SYSTEM VALIDATION FOR SHOULDER REHABILITATION

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INTRODUCTION

The increase of rehabilitation demand, especially due to ageing population, wobbles the sustainability of health care services. This situation urges the need of new rehabilitation models to reduce costs and waiting lists while maintaining high-quality rehabilitation therapies [1]. In this context arises several tele-rehabilitation systems which can control rehabilitation processes remotely. One of the keys to ensure high adherence of patients in a rehabilitation process is to give real-time feedback while performing the exercise [2]. The main objective of this study is the validation of the real-time feedback algorithm incorporated in ReHub® platform. A digital tele-rehabilitation solution, developed by DyCare®, based on the use of a single inertial sensor to offer personalized and effective remote rehabilitation therapies.

METHODS

Nine healthy subjects were measured while performing 13 times each of the 5 upper-limb exercises selected. The first trial is used to build the patient movement pattern and the other 12 trials are divided as follows: 3 well-performed sets, 3 sets performed with small range of movement and 6 sets performed including compensations (3 sets for each compensation defined). Each trial is composed of 7-10 repetitions. The angles of the main movement axis were obtained from the accelerometer and a gyroscope.

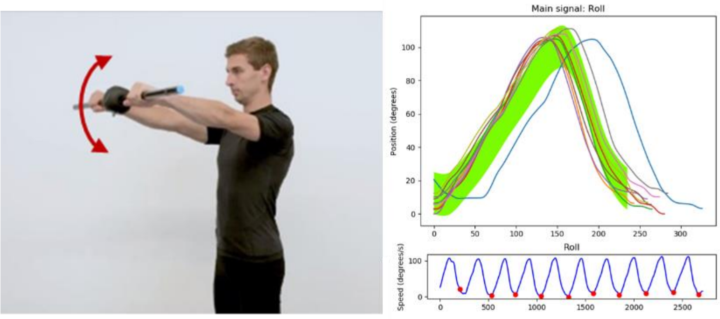

Figure 1. Example of exercise comparison with the reference

Then, the signals of interest (Euler angles of the main movement axis and gyroscopes) are analyzed using the real-time algorithm developed within DyCare® which is based on the comparison of each trial cycle with the correspondent reference cycle pattern (Figure 1).

To determine if a particular performance (performing well, errors related with range of movement, body compensation or force) is detected by the algorithm, at least the 80% of all the repetitions performed by all the volunteers must give as output the expected feedback.

RESULTS

Considering all the exercises together it was found that when the exercise is well performed, it is detected in the 89±2% of the cases. Small range of movement errors are detected in 90±7% of the cases, the compensations which include performing moments outside the main plane of the exercise are detected in 95±8% of the cases and force errors are detected in the 97±3% of the cases.

DISCUSSION

From the results achieved, it can be noted that when using a single inertial sensor, the capability of error detection is limited as it allows only to detect compensation errors involving movements outside the main plane of the exercise. Considering the simplicity of the setup, an accuracy of 93±4% is achieved which allow a first evaluation of patient performance. Therefore, the present digital solution would be useful to increase therapy adherence and efficiency. Moreover, a solution as ReHub® will greatly reduce the economic and social impacts of patients who needs rehabilitation.

Regarding compensation, future work will be addressed towards identifying the type of compensation.

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