GENERAL CONSIDERATIONS OF THE AUTHORS

We greatly appreciate the close readings of the four Reviewers and their pertinent comments that have been used to revise and improve the text. Below we reply in detail to the Reviewers’ concerns: Reviewers’ comments are written in italic and our replies follow in plain text. Changes in the revised manuscript are also highlighted in yellow.

REVIEWER #4

Comments

R#3.1

Presented work does not deal with virtual reality! What is the difference between the target printed and displayed on the screen?

Authors’ reply

We respectfully disagree with the Reviewer on this aspect. Generally, virtual reality is considered when subject is asked to perform motion in a simulated environment. We believe that our experimental protocol perfectly meets this definition. In our non-immersive VR task, subjects were asked to perform throwing without holding a real ball in the hand and in a simulated scenario. We also decided to replicate the target in the real scenario, to avoid the influence of its shape and dimension.

R#3.2

I do not see any connection of Your work with rehabilitation

Authors’ reply

We thank the Reviewer for the suggestion to better explain the relation with rehabilitation. As reported in the Introduction, upper limb rehabilitation is nowadays performed by means of virtual reality in order to increase the engagement of the participants. In addition, throwing task is commonly used for the rehabilitation of upper limbs after injuries. Finally, the effects of VR in rehabilitation field have been deeply analyzed in terms of kinematic; conversely, the effects on muscle activation is still untapped. For this reason, we strongly believe that the findings of our study can contribute to the current opinion about implementing experimental protocol based on VR able to elicit the same muscle activity for upper limb rehabilitation and guarantee a higher engagement of the participants.


R#3.3

EMG data are treated in a not proper manner! What does mean/explain: i. "grinding methods" used in EMG data postprocessing? ii. the continuous residual component (cut off at 10Hz) iii. A notch 50Hz, what about informative signals at this frequency? iv. Why You did: "Then the signal was rectified, and an additional 4th order Butterworth filter
was applied in a step-by-step mode with a cut-off frequency of 6 Hz to extract the envelope”. v. What kind of method was applied to obtain the envelope and what time window was used to do this? What was the reason of used time window range? vi. What kind of method was used to "Subsequently, each EMG signal was resampled at 1,000 samples.", and why? vii. What does mean "Finally, the 20 signals of each repetition related to the task were concatenated one after the other, attaining for each subject and each task" This description is very confusing to understand the way of the Authors’s consideration.

Authors’ reply
We thank the reviewer for the comments aimed at improving clarity of our methodology. However, the post-processing procedures we adopted are quite diffused and standard for EMG signal. In fact we adopted a well-known and accepted procedures by experts in the field worldwide, commonly used for the extraction of muscle synergies. As an example, please see the work done by Santuz et al., (reference [31]), which we considered for EMG data processing. As regard point vi, we better explained the meaning of the resampling.

Amended version of the manuscript (page 6, lines 178-179):
“Subsequently, each EMG signal was resampled at 1,000 samples in order to normalize the duration of a single throw.”

R#3.4 According to the description, skin was not prepared correctly to the sEMG,

Authors’ reply
Thank you for allowing us to clarify this aspect. We followed the methodology proposed by SENIAM for both the preparation of the skin and the electrodes placement. We also reported the skin preparation in the first version of the manuscript, please see page 5 lines 145-148 in the amended version.

R#3.5 The target (barrel) have different size in case of "real" and "virtual" experiment

Authors’ reply
. We here confirm (as reported in R#3.1) that shape and dimension of target remained the same in order to avoid bias in the results.

R#3.6 The results are described in an unsatisfactory manner, the authors do not explain why they chose this type of "statistical" processing

Authors’ reply
We thank the Reviewer for the suggestion to better explain the statistical approach. The addition of technical information on these aspects in the main text of the manuscript would decrease the readability and fluidity of the paper; for this reason, we decided to only add a reference for the technical details of performed statistical tests.

R#3.7 To many self-citations, especially in the most important parts!

Authors’ reply
We would like to underline that all the citations reported in the Introduction and Methods are pertinent and allow reader to understand the aim of the paper, the novel contribution and the well-known methodology used for the extraction of the muscle synergies. We are willing to remove those self-citations the Reviewer will find not in line with the content of the paper.