## Influence of muscle co-contraction indicators for different task conditions

Marija Radmilović, Djordje Urukalo, Miloš Petrović, Filip Bečanović and Kosta Jovanović

*Abstract*— In this research paper, arm co-contraction indicators are examined in different scenarios such as load variation, hand velocity variation, and in tasks with different precision. The experimental results show the relationship between muscle co-contraction and increase of load, velocity, or precision. According to the results, the differences in the muscle co-contraction related with gender and the age of the participants for the same task are evident. The results of the analysis for each task are in the align with the results presented in the previous research. The results of this research have made a significant contribution in analyzing human stiffness and its implementation in the human-like motion of robots.

*Index Terms* — muscle, co-contraction, musculoskeletal stiffness, biceps, triceps, anterior deltoid, posterior deltoid

Marija Radmilović is with the Mihailo Pupin Institute, University of Belgrade, 15 Volgina, 11060, Belgrade, Serbia, (e-mail: marija.radmilovic@pupin.rs).

Djordje Urukalo is with the Mihailo Pupin Institute, University of Belgrade, 15 Volgina, 11060, Belgrade, Serbia, (e-mail: djordje.urukalo@pupin.rs).

Miloš Petrović is with the School of Electrical Engineering, University of Belgrade, 73 Bulevar kralja Aleksandra, 11020 Belgrade, Serbia (e-mail: petrovic.milos@etf.bg.ac.rs)

Filip Bečanović is a joint Ph.D. student with the School of Electrical Engineering, University of Belgrade, 73 Bulevar kralja Aleksandra, 11020 Belgrade, Serbia, and the University of Paris-Est Créteil, Laboratory of Images, Signals and Intelligent Systems, 120 rue Paul Armangot, 94400 Vitry sur Seine, (email: becaphilippe@gmail.com)

Kosta Jovanović is with the School of Electrical Engineering, University of Beglrade, 73 Bulevar kralja Aleksandra, 11020 Belgrade, Serbia (e-mail: kostaj@etf.bg.ac.rs)