Université catholique de Louvain **UCL** SECTEUR DES SCIENCES ET TECHNOLOGIES

INFORMATION AND COMMUNICATION TECHNOLOGIES, ELECTRONICS AND APPLIED MATHEMATICS

Invitation à la soutenance publique de thèse

Pour l'obtention du grade de Docteur en Sciences de l'Ingénieur

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Using Robust and Optimal control theory to understand handedness and bimanual coordination

In this thesis, we study the neurophysiological basis of handedness or the individual preference for use of a particular hand, known as the dominant hand. Indeed, any motor task involves the decision of which arm to perform it with or how to coordinate the two arms. If using only one arm, humans show a preference to use their "dominant" arm, which is often more dexterous and skillful than the other one. Hand dominance also impacts bimanual coordination, as a different role is associated to each arm during a bimanual task. Such differences across the two arms cannot be explained based on anatomical aspects, since the two arms are equally strong and have the same freedom of movement. It has been reported that each arm has a specialized behavior, with the dominant arm having a better trajectory control and the non-dominant arm being more stable in front of perturbations. And yet it is still unclear why we have a dominant arm and what the neurophysiological basis of handedness is.

Amounting evidence has highlighted the importance of feedback when performing skilled movements, however, there is no control framework able to account for the differences in performance across limbs. Given the importance of feedback in motor control, we suspected that handedness was likely related to distinct feedback control strategies. In this thesis, we use optimal and robust control theory to model different feedback control strategies, and show that such distinct strategies can capture the differences in behavior observed across the two arms. We also study how the central nervous system coordinates the two arms during a bimanual task. Using optimal control theory, we highlight the impact of the joint configuration of the upper-limbs on how the two arms share the effort during a bimanual task. We show that the arm with the best spatial relationship between effort and target goal is the arm that produces the most significant effort during a bimanual task.

Altogether, the results of this thesis offer a new perspective on the differences in behavior across the two arms and highlight the fact that handedness arises from distinct feedback control strategies.

Vendredi 1er décembre 2017 à 16h30

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