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

Monsieur Guillaume LECLERCQ
Ingénieur civil en mathématiques appliquées

The velocity visuomotor transformation for manual tracking

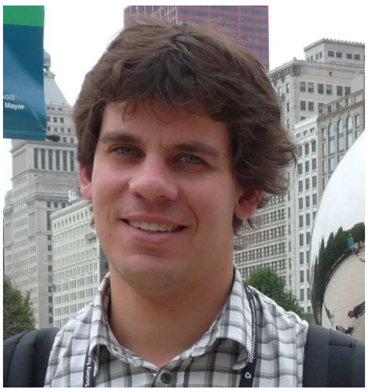
Vendredi 20 septembre 2013 à 15h00

Auditoire SUD 19
Place Croix du Sud
1348 Louvain-la-Neuve

Humans often perform visually guided arm movements in a dynamic environment (e.g. reaching, grasping, catching, hitting). To do so, the brain uses the visual (retinal) information about the target position and velocity to generate the arm movement. However, the target can be seen under different eye-head postures and/or we are often in motion ourselves (our eyes, head or whole body), which complicates the planning of the arm movement. Indeed, the relationship between the retinal and spatial motions of an object depends on the three-dimensional (3D) eye-head-shoulder geometry and kinematics while viewing the target.

This thesis investigates whether the planning of arm movements towards moving targets takes these extra-retinal signals into account (and to what extent), or whether it relies on feedback mechanisms. To test this, we asked subjects to manually track a target viewed in various 3D eye-head-shoulder configurations and we analyzed the initial arm movement direction to distinguish between theses hypotheses. To make predictions and analyze data, we also developed an accurate model of the 3D eye-head kinematics, using the dual quaternion formalism. In the thesis we show that the brain takes the extra-retinal signals about the 3D eye and head position and velocity into account for the planning of manual tracking, using an internal model of the 3D eye-head-shoulder kinematics.

Second this thesis investigates the potential neural mechanisms used by the brain to perform the reference frame transformation between the retinal input and the spatially accurate motor plan for the arm. We trained an artificial neural network with physiologically-inspired inputs and outputs to learn the 3D visuomotor transformation of velocity signals. Then we probed the artificial units properties using electrophysiology methods. Results were validated by comparing our simulated data to the neurophysiology literature and we proposed new predictions to be tested by the neurophysiology community.



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