Université catholique de Louvain UCL

FACULTE DES SCIENCES APPLIQUEES
Doctorat

Invitation à la soutenance publique de thèse

pour l'obtention du doctorat en Sciences Appliquées

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Ingénieur civil en mathématiques appliquées

Tracking the invisible requires prediction and internal models

In order to grasp an object in their visual field, humans orient their visual axis to targets of interest. While scanning their environment, humans perform multiple saccades (rapid eye movements that correct for a position error between eye and target) to align their visual axis with objects of interest. Humans are also able to track objects that move in their environment by means of smooth pursuit eye movements (slow eye movements that correct for any velocity error between eye and target, i.e. for any retinal slip).

The appearance of a moving stimulus in the environment elicits smooth pursuit eye movements with a latency of around 100ms. Accordingly, the smooth pursuit system accounts for a change in the trajectory of a moving target with a similar delay. Due to this delay, the oculomotor system needs to develop strategies to avoid the build up of position error during tracking of a moving target. To do so, the oculomotor system uses prediction to try and anticipate the future target trajectory. However, this strategy is limited to conditions where target trajectory is predictable. Otherwise, primates have to combine pursuit and saccades in visual tracking of unpredictable moving targets to avoid large position error.

This thesis focuses on both the prediction mechanisms and the interactions between saccades and pursuit. In order to investigate prediction mechanisms, we asked human subjects to pursue a moving target when it was transiently occluded. During occlusions, subjects continued to pursue the invisible target. This thesis demonstrates that this predictive pursuit response is based on a dynamic internal representation of target motion, i.e. a representation that evolves with time. This internal representation could be either built up by repetition of the same target motion or extrapolated on the basis of the pre-occlusion target motion. In addition, it is shown that during occlusions, saccades are adjusted in order to account for the large variability of the smooth pursuit response. As a consequence, it shows that the smooth pursuit command is used by internal models in order to predict future smooth pursuit response. These results demonstrate that both prediction and internal models are necessary to track the invisible and the visible.

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Vendredi 14 décembre 2007

à 15h00

Auditoire BARB94
Place Sainte-Barbe
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