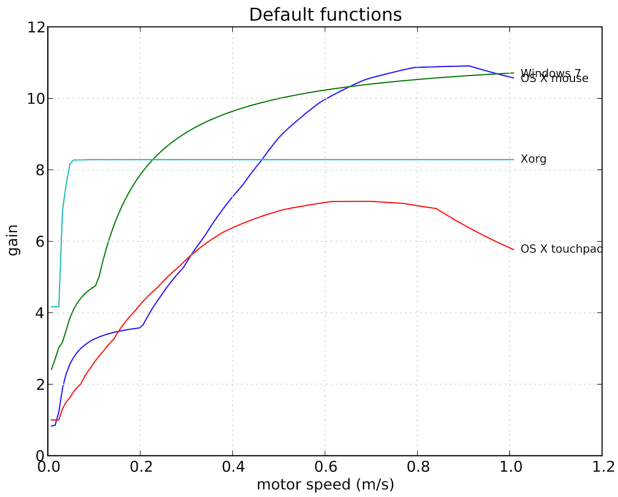
Modeling user movements to optimize acceleration functions on computer mice and touchpads

Duration : 4-6 months
Team : Loki (Inria Lille – Nord Europe & CRIStAL)
Recruiter : Mathieu Nancel (mathieu.nancel@inria.fr)

Context

Acquiring a virtual target with a mouse or touchpad requires the application of an "acceleration function" between the speed of the user's movements and that of the cursor, in order to facilitate pointing. These functions can take many different shapes (see figure on the side), but there is currently no formal method to define them: their design for a given situation is always handmade, without clear design rules or a tried-and-tested psychomotor model. In practice, although these functions have a theoretical advantage in terms of speed and accuracy, it may be difficult to demonstrate their benefits through quantitative measurements; professional gamers, for instance, are known to disable system acceleration.



Objectives

This project consists in exploring dynamic models from the motion science and neuroscience literature [1], in order to validate their applicability for the automatic or semi-automatic design of acceleration functions for the mouse or touchpad. The student will be involved in the reproduction and adaptation of existing models, as well as in their training, application in simulations, evaluation, and analysis of their results. The models developed will be initially validated on existing data sets of target acquisition, and other more specific data sets may be collected as needed.

These results will make it possible to define more effective methods for designing acceleration functions for general public applications (default functions in OSs, acceleration adapted for a given person or task), advanced applications (gaming, art), or even for the assistance of motor disabilities.

The student will be guided in reading and understanding existing movement models and their application. Models and simulations will be developed, applied and analyzed preferably in Python (Jupyter Lab). Depending on the progress of the project, these results may be submitted as a research paper.

References

[1] Bye, R.T., and Neilson, P. D. 2008. The BUMP model of response planning: variable horizon predictive control accounts for the speed-accuracy tradeoffs and velocity profiles of aimed movement. In Human Movement Science 27(5). https://www.sciencedirect.com/science/article/pii/S0167945708000377

[2] Casiez, G., and Roussel, N. 2011. No more Bricolage! Methods and Tools to Characterize, Replicate and Compare Pointing Transfer Functions. In ACM UIST '11. http://direction.bordeaux.inria.fr/~roussel/publications/2011-UIST-libpointing.pdf

Candidate

The candidate must demonstrate an interest in HCI, and programming skills; knowledge of cognitive science is a plus. He/she will have to demonstrate technical and conceptual creativity.

A good level of technical and scientific English is also a plus.