The Loki research group at Inria (France) is looking for a PhD student starting fall 2020 to work on the design, implementation, and evaluation of Fine-Grained Temporal Interactions, funded by the ANR JCJC Causality Grant.

**Context**

The vast majority of interactive systems today, including the more novel touch-based, gesture-based, or mixed-reality interfaces, remain engineered towards the early WIMP (Windows-Icons-Menus-Pointer) style in which it was more important to match the interface to the capabilities of the computer than of the user. While sufficient for implementing classic interactive systems, these standard mechanisms form a near-ubiquitous software scaffolding that constrains and influences how everyday interactions are designed, implemented, and even contemplated today. Any feature, behaviour, or capability not allowed by this implicit standard has to be hacked around.

This PhD focuses on the temporal aspects of this status quo. Interaction usability suffers from untimely responses from the system, such as input-to-output latency, which can affect performance even when it is not perceived by the user. Latency is generally seen as unavoidable until better hardware is released, in opposition to phenomena such as Blinn's Law\(^1\) and Wirth's Law\(^2\). Latency can instead be solved with careful interaction design, e.g. by forecasting the near-future of the user's input \([1,2]\). This however requires extended knowledge about how users move and react to prediction errors, as well as accurate information about the timings of the system's input and output events.

Another issue of interest to us is interaction interference, when the interface changes while or just before the user completes an input, and too late for her to cancel her motor action—for instance, a pop-up window appears above a link 10 ms before that link is clicked. When this happens, the system implicitly assumes that the user perceived and acknowledged the pop-up's contents, decided to click it, and acted upon that decision, all in less than 10 ms. Unfortunately, the granularity of information necessary to check the realism of that assumption after a click is not available to everyday interaction designers, nor do we have sufficiently fine models of human reactivity to calibrate that check. Solutions to this family of issues can be found in the way interaction is designed and engineered towards users, which is a core tenet of the research conducted at the Loki research group.

**Objectives**

This project stems from the observation that today's default models of interaction design remain streamlined towards computers rather than users, especially when dealing with fine-grained temporal interaction. In particular, accurate timing information about input and output events—and everything that happens in between—is under-used and forgotten too systematically, while it could contribute to solving a number of usability issues. The PhD will aim to:

1. **Identify and characterise the resulting usability issues**, e.g. the unwanted consequences of latency compensation algorithms, or unexpected changes in an interface right at the time the user is about to complete an action,
2. **Understand their causes, on both human and system sides**, and in various contexts of interaction that could range from classic desktop setups to augmented reality and beyond, and from it,
3. **Design, engineer, and evaluate interactive systems** better adapted to the capabilities of their users.

The PhD will contribute to the field of HCI in terms of *Human Factors*, via the analysis and modelling of the limitations of the human visuomotor system when interacting with fine-grained temporal events; *Engineering of Interactive Systems*, by documenting the limitations of today's interaction design paradigms and proposing new ones; and *Interaction Design*, when developing and evaluating interactive solutions to the identified usability issues.

**Location**

The PhD candidate will join the Loki research group, based in the Lille - Nord Europe Inria research center in the Lille area. Loki is one of the most active HCI research groups in France, with frequent publications in ACM CHI and UIST. Lille is at the northern tip of France, respectively 30, 60, and 90 minutes away in train from Brussels, Paris, and London. Its metropolitan area, situated at the crossroads of northern continental Europe, is the 5th biggest in France.

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1. "As technology advances, rendering time remains constant." \[3\]
2. "Software is getting slower more rapidly than hardware is becoming faster." \[4\]
Candidates
Candidates must hold a MSc in Human-Computer Interaction (or equivalent), and show a great interest in performing high-quality research. They must demonstrate experience or strong interest in software engineering and programming. Creativity, independence, team working and communication skills are valuable advantages, as well as a good level of technical and scientific English. A track record of publications in top-tier HCI venues (such as ACM CHI, UIST, CSCW) is expected, as well as a significant track record of design and implementation of interactive systems and GUIs. It is not required to speak French. If interested in this project, simply e-mail Mathieu Nancel (mathieu.nancel@inria.fr) and Géry Casiez (gery.casiez@univ-lille.fr).

References