

Research Topic for the Arts et Métiers ParisTech - CSC PhD Program

Subfield: Virtual reality, mathematics, computer science

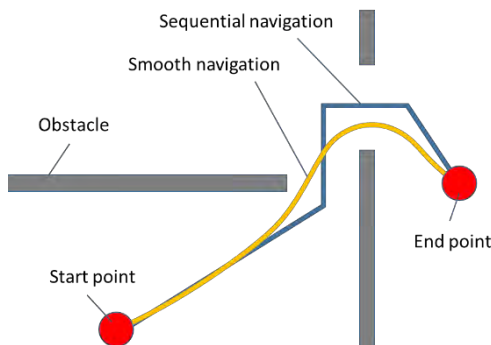
ParisTech School: Arts et Métiers ParisTech (ENSAM)

Title: Intelligent navigation in virtual environments

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Short description of possible research topics for a PhD: Navigation in real environments is a common task that the human beings performs unconsciously. Transposing this task in virtual environments (VE) is however a great challenge that has being investigated for several years. Indeed, navigating in VEs requires using a device that can be (i) intrusive, (ii) non-natural (e.g., walking in place, navigation devices coming from the video game field). The use of a navigation device hence induces non-smooth movements in VEs. On the other hand, most of the technologies used in virtual reality (VR) rely on user immersion in a narrow space, the so-called CAVE being the most common example. These systems can be constraining because the user is often not at the center of the process. These two facts can induce a cognitive overload and in the worst case the so-called simulator sickness.

In parallel, the humanoid robotics field has focused on the evolution of humanoids in real environments since a few years. Indeed the main research question is: how to make a robot evolve in a smooth and optimized way and not in a sequential way (as done in VR for instance)?



The proposal of this PhD thesis is (i) to make a complete exhaustive up-to-date state-of-the-art on navigation interfaces and techniques in VR, (ii) to adapt the methods from the humanoid robotics field to navigation in VR, by improving the navigation metaphors based mostly on a sequential evolution in a VE toward a smooth, continuous and optimized way in real-time, then (iii) to integrate user's intention to make navigation as close-to-real as possible and

lower possible delays. The aim will also be to reduce induced sickness by improving user's involvement. The effectiveness of the methods will be assessed through experiments.

Required background of the student: Mathematics, computer science (programming)

A list of 5 (max.) representative publications of the group:

- [1] M.-A. Mirzaei, J.-R. Chardonnet, F. Merienne, and A. Genty, "Navigation and interaction in a real-scale digital mock-up using natural language and user gesture," in *Laval Virtual VRIC'14*, Laval, France, 2014, pp. 1–4.
- [2] M.-A. Mirzaei, "Influence of interaction techniques on VIMS in virtual environments: estimation and prediction," PhD thesis, Ecole Nationale Supérieure d'Arts et Métiers, Chalon-sur-Saône, France, 2014.
- [3] J.-S. Casallas, J. H. Oliver, J. W. Kelly, F. Merienne, and S. Garbaya, "Using relative head and hand-target features to predict intention in 3D moving-target selection," in *IEEE Virtual Reality (VR)*, Minneapolis, USA, 2014, pp. 51–56.

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