

# Multi-user Telepresence Systems for Remote Collaboration across Wall-Sized Displays

Master-level internship 2018

**Research team:** ExSitu - Inria, Saclay.

**Lab:** Laboratoire de Recherche en Informatique, Bât. 650, campus Université Paris-Sud.

**Advisors:** Cédric Fleury ([cfleury@lri.fr](mailto:cfleury@lri.fr)), Michel Beaudouin-Lafon ([mbl@lri.fr](mailto:mbl@lri.fr)).

**Keywords:** telepresence, computer-mediated communication, wall-sized displays.

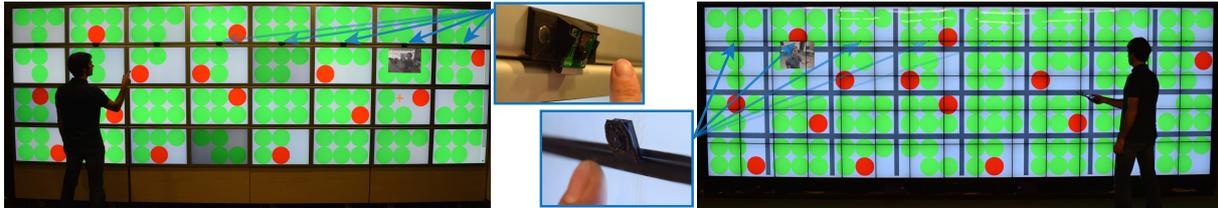


Figure 1: *CamRay* embeds an array of camera in two wall-sized displays for remote collaboration [2].

## Context:

With the increase of computer power, large and complex datasets are becoming common in science, industry, business and society. Wall-sized displays [3] are powerful tools to enable users to analyze such data and perform complex manipulation tasks. They allow to display large amounts of data with a high resolution and naturally support multiple users collaborating in front of the display [4]. However, remote collaboration in such environment is still a challenge since it is difficult to capture video of moving users and to display their video feeds in an appropriate manner on the remote displays. This internship will take place in the context of the DIGISCOPE project (<http://www.digiscope.fr/>), which is creating a network of ten interconnected platforms, including virtual reality systems, large 3D displays and wall-sized displays, on the Paris-Saclay campus.

## Description of the internship:

To explore remote collaboration across two wall-sized displays, we designed *CamRay* [2] (Fig. 1), a system that uses an array of cameras embedded in each display to capture live video of the users as they move in front of the display. At the remote side, *CamRay* overlays the video feed on top of the content and we implemented two methods for positioning this video: *Follow-Me* and *Follow-You*. With *Follow-Me*, the video window follows the horizontal position of the *local* user, providing constant visual contact with the remote person. With *Follow-You*, the video window follows the horizontal position of the *remote* user, conveying his or her position in front of the display. We ran various experiments and observed that each method has advantages: *Follow-You* works well for conveying pointing gestures [1], while *Follow-Me* creates a virtual face-to-face that is beneficial for one-to-one communications.

The goal of this internship is to continue this work by investigating ways to switch between the two video modes and by adding new visual cues. For example, in a simple classification task in which two remote users have to divide objects among several categories, they can first use *Follow-You* to be aware of the partner's position and efficiently split the work between them. But, if they need to discuss how to classify a particular object, they can have a face-to-face conversation with *Follow-Me* without having to move in front of each other. The solution designed to achieve this switch will have to consider the technical aspects, the user actions required to trigger the switch and the social aspects. We must avoid complex actions to begin or end a virtual face-to-face. It will be interesting to test semi-automatic ways to switch between modes by taking into account the users' behaviors. With respect to the social aspects, we want to find how to engage in a virtual face-to-face with mutual agreement and avoid abrupt transitions that might hinder collaboration.

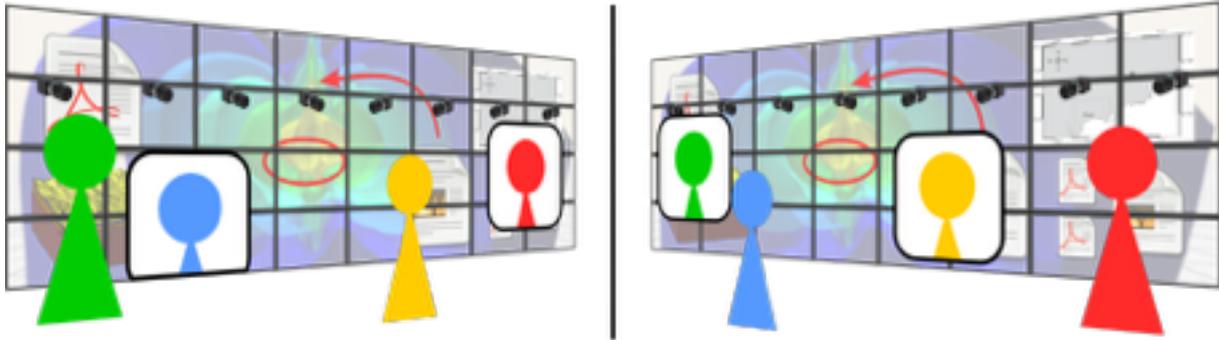


Figure 2: multiple users in each location represented by their video on the remote wall-sized display.

Since the virtual face-to-face created by *Follow-Me* makes it more difficult for a user to interpret the pointing gestures of their partner, we want to explore visual cues such as showing a (synthetic) shadow of the remote user on the local display, showing the visual context of the remote user around the video feed on the local display, or highlighting the objects pointed by the remote user. Here too, the technical, social and interaction aspects will have to be studied together to provide practical solutions.

Finally, the internship will also study how to scale the approach to support collaboration with several users per remote location. In particular, we envision a scenario in which all the users could be represented by an avatar on the remote wall-sized display using the *Follow-You* mode (Fig. 2). But, if a user wants to engage in a one-to-one conversation, she could designate another user and start a virtual face-to-face using the *Follow-Me* mode.

If successful, the work will be submitted to a the top conference in Human-Computer Interaction, ACM CHI. This internship can also lead to a Ph.D. in our research group.

### Requirements:

We are looking for students who are interested in research in Human-Computer Interaction, especially in computer-mediated communication and remote collaboration. Solid programming skills are required as the student will have to deal with clusters managing rendering on our two wall-sized displays. Experience with video streaming or cameras is appreciated.

### References:

1. Avellino I., Fleury C., and Beaudouin-Lafon M. [Accuracy of Deictic Gestures to Support Telepresence on Wall-sized Displays](#). In *Proceedings of the Conference on Human Factors in Computing Systems (CHI '15)*, 2015.
2. Avellino I., Fleury C., Mackay W., and Beaudouin-Lafon M. [CamRay: Camera Arrays Support Remote Collaboration on Wall-Sized Displays](#). In *Proceedings of the Conference on Human Factors in Computing Systems (CHI '17)*, 2017. [[video](#)]
3. Beaudouin-Lafon, M., Huot, S., Nancel, M., Mackay, W., Pietriga, E., Primet, R., Wagner, J., Chapuis, O., Pillias, C., Eagan, J., Gjerlufsen, T., and Klokmoose, C. 2012. [Multisurface interaction in the WILD room](#). *IEEE Computer* 45, 4 (2012), 48–56. [[video](#)]
4. Liu C., Chapuis O., Beaudouin-Lafon M., and Lecolinet E. [Shared Interaction on a Wall-Sized Display in a Data Manipulation Task](#). In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI '16)*, 2016. [[video](#)]