SGCS: Stereo Gaze Contingent Steering for Immersive Telepresence
Remi Cambuzat, Frederic Elisei, Gerard Bailly

To cite this version:

HAL Id: hal-01677481
https://hal.archives-ouvertes.fr/hal-01677481
Submitted on 8 Jan 2018

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
1.1 Research framework: Embodied Learning

Our goal is to “teach” a robot to interact autonomously in a face-to-face task with a human. Due to the complexity of the task, standard learning approach like learning by observation and kinesthetic demonstration are not efficient, notably for demonstrating social signals (such as gaze or head movements). Our approach consists in exploring the embodied learning paradigm, where a human pilot teaches the robot with his/her own moves [10]. Like a puppeteer, a pilot controls the robot remotely using an immersive social display. In order to record an interaction with minimal bias, the platform should become "transparent" and the remote world represented in a "natural" way. Our research aims at providing the pilot with an active perception of the remote space, notably with a trustful and coherent perception of depth.

1.2 State of the Art

What we know about humans:
- Depth perception is based on several factors: Binocular disparity (stereovision), occlusion, parallax, convergence, known semantics of the objects, ... [11, 5].
- Stereoscopic vision is useful before 15m (cannot differentiate from monovision after [1])
- Vergence is useful in the per-personal space (<2.0m) [14]

Current use of immersice teleoperation
- Search and rescue robot [9]
- Drone navigation [4]
- Immersive telepresence [6, 7, 3]

Gaze controlled methods
- Virtual gaze joystick: “Moving to the center” [17] [12]
- EyeSeeCam [11, 13]

Limitations of current immersive teleoperation devices
- Underestimation of depth in peripersonal space (<2m), overestimation after 2m [2].

Drawbacks: In those setups, the stereo rig is fixed. The pilot loses the vergence information.

Control of vergence improves perception and evaluation of virtual reality before for most of them (13 inexperienced VR).

4.1 Setup & protocol

Setup: 7 target at various distance (25 to 100cm)
Protocol: For the reference condition (Ideal target angles determined semi-automatically) and the pilot, every target has been seen 8 times. On 4 passes (left->right, front->back, right->left, back->front) repeated two times.
Subjects: 16 subjects (3 women, 13 men), aged between 22-56 yo. No prior experience of virtual reality before for most of them (13 inexperienced VR).

4.2 Results

4.3 Platform validation

5. Discussion & future works

Discussion: Our SGCS control method is able to move the robotic eye in coherence with the orientation of the human eye (the camera’s optical axes are aligned with the human eye). The cameras are looking where the human is looking with respect to tilt, azimuth, and vergence.

Future works: * Hypothesis: Control of vergence improves perception and evaluation of depth in the near and medium field while maintaining oculomotor cues and reducing the accommodation-vergence conflict.
* Improve the reactivity of the control method: detection of fixation and saccade.