3D Sketching in Virtual Reality

Master Internship proposal 2021-22

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Durée: 6 mois

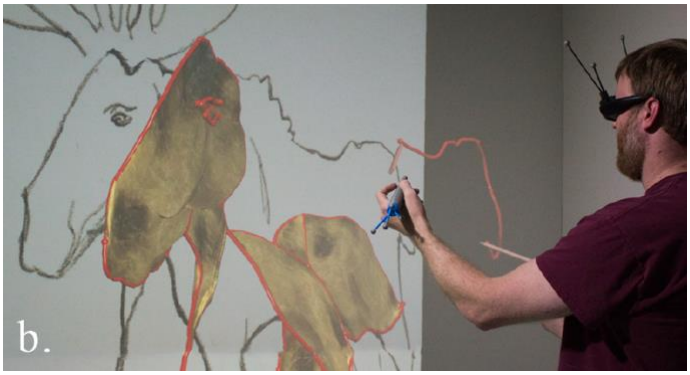
Research topic

Since virtual reality (VR) is available for the general thanks to affordable headsets, completely new experiences in creating 3D content are possible. The modeling of 3D shapes in an immersive environment is the topic of this internship. Unlike the use of a classic geometric modeler (CAD software for example) where the user is in front of a computer screen and draws in a plane with his mouse, the user in VR has a joystick that allows to draw directly in 3D. Moreover, in addition to the 3D positions of the drawn curve, the joystick also transmits orientations, i.e. a local coordinate system in each position. We will use the HTC Vive headset for VR immersion and its controllers for drawing.

The goal of the internship is to develop an application allowing to draw 3D shapes in a VR environment. The challenges that we offer the intern to take up are multiple:

- The first challenge comes from the nature of the data: we have not only 3D curves but also orientations. How to exploit these orientations for the creation of shapes?
- The second challenge concerns the accuracy of the data captured. How to model a smooth and visually pleasing 3D shape from noisy data? How important is noise?
- The third challenge relates to the precision of the user's gesture: despite the user's immersion close to the 3D shapes, previous work suggests that the drawing gesture is far from precise [2].

We already have at our disposal the computer tool allowing the creation of surfaces (open with border) in VR. The intern can use it and integrate the new methods to be developed. In this internship the emphasis is on geometric modeling of a closed surface from 3D ribbons that the user roughly sketches in VR using the HTC Vive controller. The geometric interpretation of the 3D sketch and its transformation into a geometric model is the problem to be solved.



source : [4]

Required skills

We are looking for a student with a combined math-informatics profile who is interested in geometric algorithms and data structures and graphical programming and who has good knowledge of linear algebra, numerical methods and who can easily program in C ++. Curiosity and enthusiasm are essential too. Programming experience with (surface meshes or volumes) is a plus.

Information for applicants and requirements

The internship will take place in the ANIMA team at INRIA Grenoble, 655 avenue de l'Europe, 38330 Montbonnot. The candidate should have good knowledge in geometric modeling and numerical algorithms and solid experience in computer graphics programming.
Please send your application (CV, University transcripts Bachelor and Master and motivation) to Stefanie Hahmann and Georges-Pierre Bonneau.
Feel free to contact Stefanie Hahmann for any further information about the internship.

Bibliography

[1] Tilt Brush, by Google
[2] Experimental Evaluation of Sketching on Surfaces in VR, Arora, Rahul and Kazi, Rubaiat Habib and Anderson, Fraser and Grossman, Tovi and Singh, Karan and Fitzmaurice, George, Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems, (2017)
[3] Lift-Off: Using Reference Imagery and Freehand Sketching to Create 3D Models in VR. B.Jackson, D.Keefe. IEEE TVCG 2016.
[4] A divide-and-conquer approach for automatic polycube map construction. Ying He, Hongyu Wang, Chi-Wing Fu, Hong Qin, Computers and Graphics 33, 369-380 (2009).