EPFL

CS-444   **Virtual reality**

Boulic Ronan

Cursus	Sem.	Type
Computer science	MA2, MA4	Opt.
Cybersecurity	MA2, MA4	Opt.
Data Science	MA2, MA4	Opt.
Digital Humanities	MA2, MA4	Opt.
Robotics, Control and Intelligent Systems		Opt.
SC master EPFL	MA2, MA4	Opt.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	During the semester
Workload	120h
Weeks	14
Hours	**3 weekly**
Courses	2 weekly
Exercises	1 weekly
Number of positions	

Summary

The goal of VR is to embed the users in a potentially complex virtual environment while ensuring that they are able to react as if this environment were real. The course provides a human perception-action background and describes the key techniques for achieving efficient VR applications.

Content

The first lectures focus more on the technical means (hw & sw) for acheiving the hands-on sessions:

- Visual display
- Interaction devices and sensors
- Software environment (UNITY3D)

The proportion of more theoretical VR and Neuroscience background increases over the semester:

- Key Human perception abilities, Cybersickness, Immersion, presence and flow
- Basic 3D interaction techniques: Magic vs Naturalism
- The perception of action
- Haptic interaction
- What makes a virtual human looking alive ?
- Motion capture for full-body interaction
- VR, cognitive science and true experimental design

Keywords

3D interaction, display, sensors, immersion, presence

Learning Prerequisites

Required courses

(CS 341) Introduction to Computer Graphics

Recommended courses

(CS 211) Introduction to Visual Computing

Important concepts to start the course

from Computer Graphics:
- perspective transformations

- representation of orientation
- 3D modelling hierarchy
- matrix algebra: translation, orientation, composition

Learning Outcomes

By the end of the course, the student must be able to:

- Describe how the human perception-action system is exploited in VR

- Apply the concepts of immersions, presence and flow

- Give an example of applications of VR in different industrial sectors

- Choose a method of immersion suited for a given 3D interaction context

- Explain the possible causes of cybersickness in a given VR system configuration

- Design a VR system involving 3D interactions

Transversal skills

- Set objectives and design an action plan to reach those objectives.

- Assess one's own level of skill acquisition, and plan their on-going learning goals.

Teaching methods

Ex cathedra + Hands-on sessions on VR devices in the first half of the semester,
A mini-project in groups of 2-3 persons will have to integrate various components of 3D real-time interaction. The group will submit their project proposal to the course responsible TAs who will assess whether it meets the key specifications and is original enough. The proposal will include the use of some VR devices that the IIG research group will lend during the mini-project period.

Expected student activities

exploit citation analysis tools to evaluate a scientific paper
combine 3D interaction components to produce an original 3D experience
experiment the hands-on practical work in the lab
synthesize the knowledge acquired in course and hands-on in the quizzes and final oral

Assessment methods

- Projet : 50% by groups of 2-3 persons (includes an individual oral check of contribution to the project code)
- Paper study : 20% (individual written work on a scientific article/each student studies a different paper)
- Online oral exam : 30% on the paper study extended to broader VR topics

Supervision

Office hours	No
Assistants	Yes
Forum	Yes

Resources

Virtual desktop infrastructure (VDI)
No

Bibliography
- Course notes will be updated and made available after each course, with links to key sites and on-line documents
- J. Jerald, The VR Book, ACM Press 2015

- Parisi, Learning Virtual Reality, O'Reilly 2015
- Le Traité de Réalité Virtuelle (5 vol.) Presses des Mines, ParisTech, 2006-2009, available on-line, free for student upon registration.
- Doug A. Bowman, Ernst Kruijff, Joseph J. LaViola, and Ivan Poupyrev. 2004. 3D User Interfaces: Theory and Practice. Addison Wesley Longman Publishing Co., Inc., Redwood City, CA, USA.

Ressources en bibliothèque

- 3D User Interfaces: Theory and Practice / Bowman
- Learning Virtual Reality / Parisi
- The VR Book / Jerald
- Le Traité de Réalité Virtuelle / Fuchs

Notes/Handbook

pdf of slides are made visible after the ex-cathedra courses