

# **PV160**

# **HCI Lab + Visit Lab**

Semester Kickoff Meeting,  
autumn 2022

# Course Basics

- Individual or team work on research projects related to HCI or Visit labs
- Each student has a “supervisor” to consult with
- Evaluation based on mid-semester and end-semester presentations of your work
- No fixed teaching schedule, individual/team consultations
- Possible basis for long term cooperation - Bachelor, Master theses

# The LAB

- This room (A421)
- Opened 24/7, [shared google calendar](#)
- Equipment:
  - Stereoscopic projection screen
  - Motion Capture system
  - VR headsets: HTC Vive, Oculus/FB/Meta Quest, ...
  - 3D printers
  - Force Feedback devices

# Goal of Today's Meeting

- From the list of topics, select the one(s) of your interest and discuss it (them) with the corresponding supervisor(s)
- Today or in the following days (until Friday, Sept. 23), agree with a supervisor on your topic and discuss the time schedule
- After agreeing on the topic, you will be finally enrolled in the course (you need to ask for permission through information system)

# Possible topics

- List of prepared topics, will be presented by their supervisors.
- You can come with your own idea for the project, we will discuss them individually after the presentation today.
- Now take a notebook and mark titles and supervisors of interesting topics...

**(long) list of topics...**

# Spectatorship Experience

Spectating other people playing games has become a mass phenomenon over the last years

This can range from small gatherings around the family table following a board game to large e-sport events attracting up to millions of viewers

This raises new design challenges for HCI:

- How can spectator experiences be facilitated in order to pro-actively involve spectators instead of being passive observers?
- How can an approach look like to make games more accessible for the audience, to spark interest, and to stimulate a feeling of togetherness?
  - <https://seegamesws.wordpress.com/>
  - <https://esportshci.wordpress.com/>

Contact: Simone+Tomáš

Contact - Simone



Image from <https://mitcentralcoast.org/wp-content/uploads/2018/08/esports.jpg>



Image from <https://www.computerhowtguide.com/wp-content/uploads/2016/12/playing-games.jpg>

# In-Game Visualization

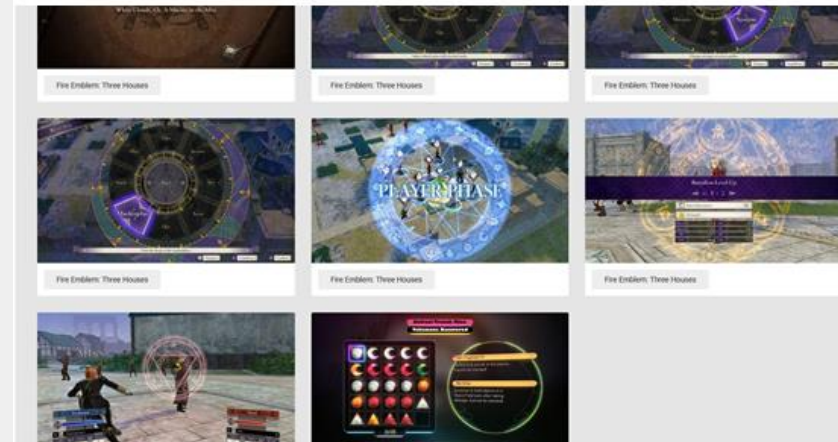
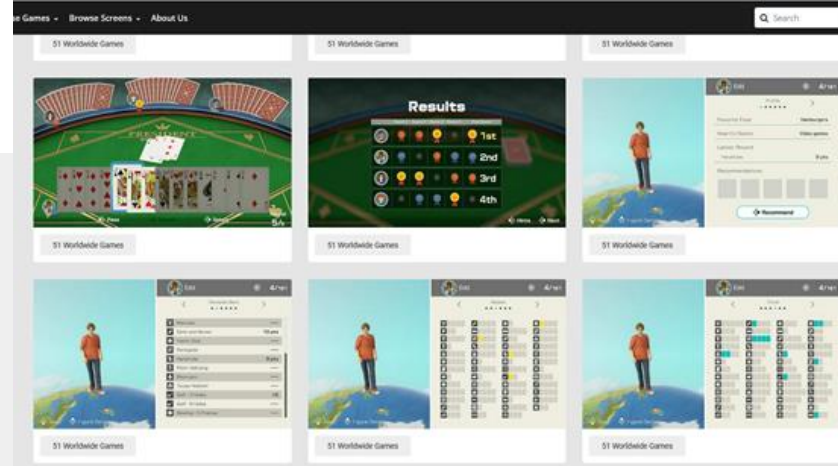
Visualizations in games become more and more important in order to give feedback and as UI element

The [Game UI Database](#) was developed as a free resource for UI/UX designers in the games industry with the goal

- to discovery new inspiration
- to provide reference materials

## Goal:

- To analyze the Game UI database regarding visualizations which are used as part of game interfaces
- The different games and screenshots in the database should be categorized according to the used visualizations
- The visualizations should be analyzed with respect to different criteria such as purpose, genre, tasks, year, and others
- This is part of an open master topic "[In-Game Visualization Browser](#)"



Contact: Simone



# Playful Research Method

**Challenge: How might we make user research more fun for the users?**

The success of a product depends strongly on if users use it or not. A key factor is to make the product usable, efficient and pleasant to use. To involve users already in the development process will help you to identify what your product should have and to get feedback from them regarding what works and what not. To collect this information, there exist different methods, e.g. interviews, observations, surveys.

However to find enough participants who are willing, e.g., to fill out a questionnaire is not always easy. A solution can be to make it more playful. How such playful approaches can look like to collect user information regarding their needs, experiences, opinions, etc.?



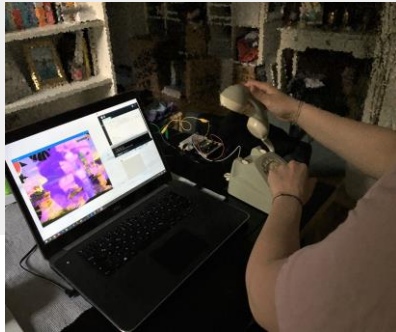
Photo by [Ylanite Koppens](#) from [Pexels](#)

Contact: Simone

# Reusable Object/Playful Object

Developing for a game or for an object an alternative controller/input devices to control this game/to use this object.

- You can use an old object that is no longer used
- You can use an object (e.g., vacuum cleaner) to make the usage of this object more playful



Contact: Simone

# Map Visualization

Implementing two map representation into an explorative game where one map shows the complete environment while the second map only reveals those parts where the player has moved. For example, using an open source (demo) game or a Game Kit such as the 3D Game Kit from Unity:

<https://assetstore.unity.com/packages/templates/tutorials/3d-game-kit-115747#reviews>



Photo by Andrew Neel from Pexels

Contact: Simone

# Quantified self at work and digital humanism

Quantified-self technologies (QSTs) *"those technologies that help people collect personally relevant information for the purpose of self-reflection and gaining self-knowledge"* (Li et al., 2010)

Aim and task: Development of a self-tracking tool to improve productivity at work. Integrate a set of design (gamification) elements into it and test the acceptance of these elements. Investigate the extend to which these elements create "conditions of worth" or support "self-reflection".

## Relevant work:

- Choe, E. K., Lee, N. B., Lee, B., Pratt, W., & Kientz, J. A. (2014). Understanding quantified-selfers' practices in collecting and exploring personal data. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 1143–1152. <https://doi.org/10.1145/2556288.2557372>
- Avrahami, D., Williams, K., Lee, M. L., Tokunaga, N., Tjahjadi, Y., & Marlow, J. (2020). Celebrating Everyday Success: Improving Engagement and Motivation using a System for Recording Daily Highlights. Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems, 1–13. <https://doi.org/10.1145/3313831.3376369>
- Sailer, M., Hense, J. U., Mayr, S. K., & Mandl, H. (2017). How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction. Computers in Human Behavior, 69, 371–380. <https://doi.org/10.1016/j.chb.2016.12.033>
- Feng, S., Mäntymäki, M., Dhir, A., & Salmela, H. (2021). How Self-tracking and the Quantified Self Promote Health and Well-being: Systematic Review. Journal of Medical Internet Research, 23(9), e25171. <https://doi.org/10.2196/25171>



Photo by Pixabay

Contact: Simone

# COO - HCILab Mascot

Bring our HCILab mascot to life with the help of AR

- With the help of markers, which we will stick in the lab and at the entry of the lab
- Different animation for each marker
- Should work with smartphones and tablets

Model is created by Hanka based on the draft from Danielle



Contact: Simone+Hanka+Danielle

# Cognition Mini Games for Esports Training

E-Sport players need to practice the skills necessary for optimal performance. One area we wish to explore is cognitive training. We want to create some minigames to this end, these games could be focused on memory, reaction time, attention, reasoning, or other related domains.

Your task would be working with us to design and develop a minigame within the domain of cognition. We also need to develop means of reliably accessing the data from this minigame for research purposes and to track skill development. We can discuss VR as an option as well.



Photo: Yan Krukov from Pexels  
<https://www.pexels.com/photo/gaming-setup-for-competitive-esports-9072394/>

Contact: Simone + Danielle

# Roll the Dice Game

## A demonstrator for an Adaptive Learning Technology called adlete

E-Sport players need to train and practice their ability to respond and to memorize behaviors or actions. A valuable combination training for both abilities is "Roll the Dice". A player rolls a dice and must fulfill a certain hand gesture regarding the number.

Convert this analog game into a Unity Desktop Application by using a given gesture recognition technology (e.g. Microsoft Kinect)  
We can also talk about VR Solution



### Roll the Dice

Überlege dir sechs Aktionen, die deine Hand je nachdem, welche Augenzahl gewürfelt wird, durchführen soll, zum Beispiel: Bei einem Auge schnipse mit der rechten Hand, bei zwei Augen strecke Zeige-, Mittel- und kleinen Finger der linken Hand, beuge Daumen und Ringfinger und lass sie sich berühren, bei drei Augen klatsche in die Hände, bei vier Augen berühre mit dem rechten Zeigefinger den linken Mittelfinger, bei fünf Augen bilde eine Faust mit der linken Hand und bei sechs Augen mache mit der rechten Hand das Peace-Zeichen. Stelle dich hin, würfle oder lass deinen Trainer beziehungsweise Trainingspartner würfeln und versuche, so schnell wie möglich die geforderte Aktion durchzuführen.

Knoll, Stefanie; Wachholz, Felix (2020): E-Sport-Fitness. Trainiere Reaktionsschnelligkeit, Koordination und Konzentration, um deine Gaming-Skills zu maximieren. Mit über 90 Übungen. München: Riva.

Contact: Simone + Flo

# 3D Printing and Physics Simulation

Explore the possibilities of printing movable “mechanisms” such as gimbal or pendulum

- Design such mechanism,
- Implement a physics simulation (using suitable SW package)
- 3D print it
- Compare results of simulation and real behavior



Contact: Jirka



# Motion Capture Demo

Get familiar with Motion Capture technology. Design and create a short demonstration of capabilities of this technology

- Capture 3D data and video footage
- Clean MoCap data
- Use MoCap data in:
  - blender
  - Unity
  - Unreal
- Create a video of result



Contact: Jirka

# Haptics Device Revival

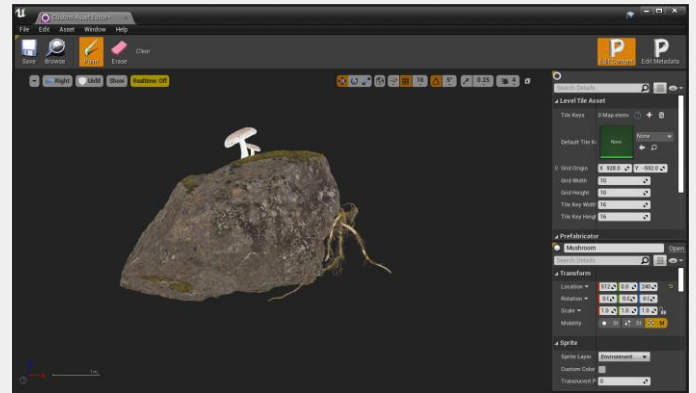
- Get familiar with technology
- Try to get it working on modern OS
- Implement simple SW demo



Contact: Jirka

# Custom Editor for Prefabricator in UE4

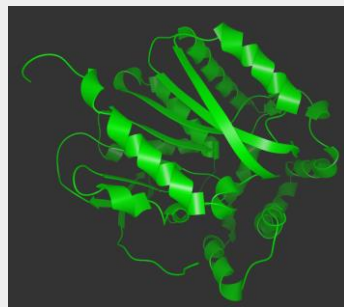
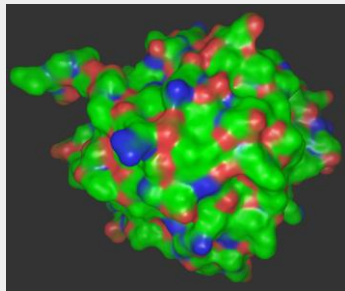
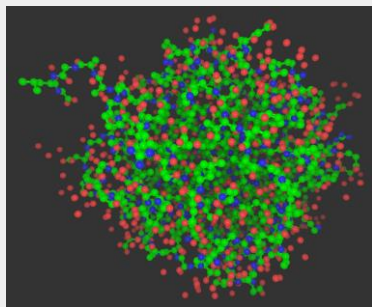
- Edit Prefabricator assets in a separate window
  - experience how tools programming in gamedev works
  - good understanding of C++ required
  - <https://prefabricator.dev/>



Contact: Jan

# Molecular Visualization for Web

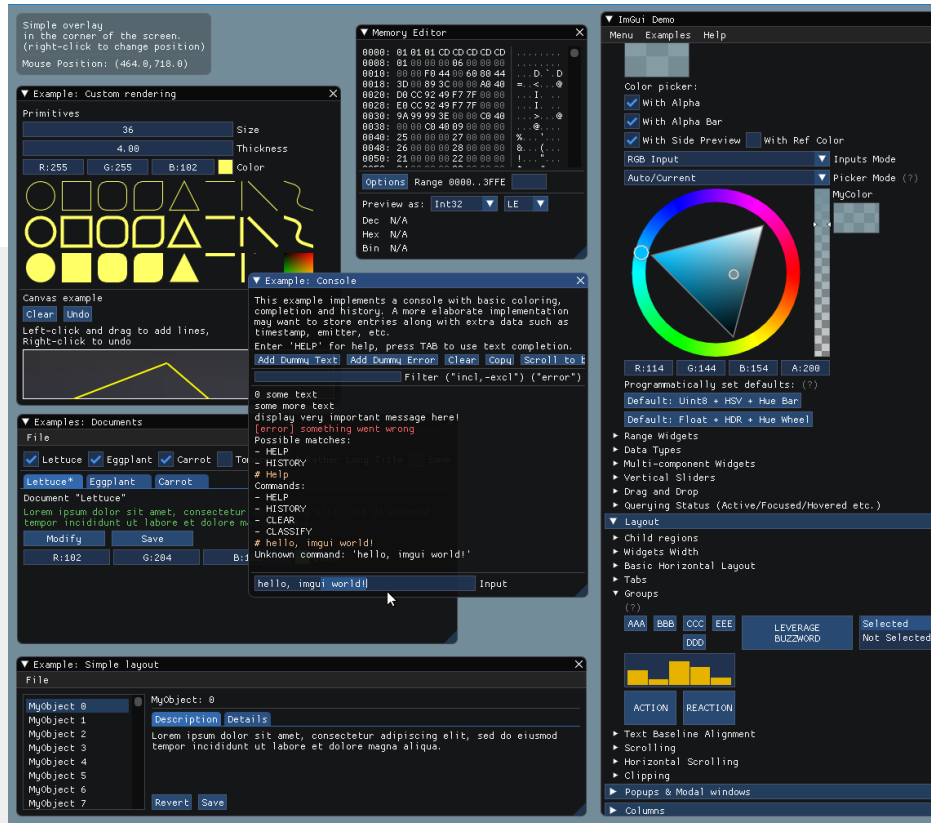
Implement various 3D molecular (static and dynamic) scalable visualizations using WebGPU and WebAssembly



Contact: Jan

# ImGUI Builder

Implement a better integration for ImGUI builder with webassembly.



Contact: Jan

# HAIE - Healthy Aging in Industrial Environment

Analyze large longitudinal cohort study data



Contact: Jan, Katka

# Project Tsunami: Raise the Ground for VR Teleport

**Background:** VR teleportation uses a “pee stream” to point over the landscape to teleport. What if, instead of curving the pointing line, we would curve the world?

**Task:** Implement an alternative teleportation system in VR that curves the landscape upwards with every start of the teleportation sequence to select a destination.

Suitable for **Bc.** thesis



Contact: Matěj



# Motorb: Guardians of the Galaxy Propulsion Controls

**Background:** Sometimes technology inspires sci-fi, sometimes it goes the other way around. Let's explore an alternative control system for a spaceship in VR.

<https://youtu.be/phX13S9zarQ?t=155>

**Task:** Implement vehicle steering system using hand tracking capabilities of Oculus Quest 2.

Suitable for **Bc.** thesis



Contact: Matěj





# Muscle Charts: Line Chart Uncertainty Representation

**Background:** A new visualization technique of uncertainty takes existing data properties into account.

**Task:** Implement a D3 line chart with uncertainty visualization.

Contact: Matěj



# Progressive Uncertainty

**Background:** Journalists use visualizations often and need to communicate the data correctly. How to go about it if the dataset is messy and full of uncertainties?

**Task:** Implement a visualization that will progressively show more details and overlays.

Contact: Matěj



# Recipe Variations

**Background:** Single food recipe can have multiple variations found on the internet. What do they have in common and what differs?

**Task:** Find and visualize recipe variations. Use interactive visualization techniques for data exploration.

Contact: Matěj



# Patrolling games visualization

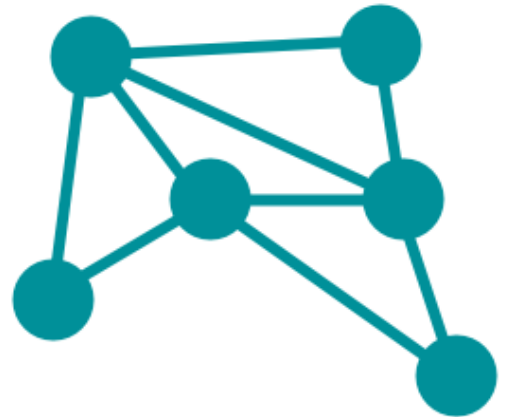
**Background:** Patrolling games are played on graphs. The vertices are vulnerable spots, the edges are paths between them. The guard visits vertices based on a strategy with an element of randomness.

**Task:** Visualize strategies of the guards on the graphs.

Suitable for **Bc.** thesis

In collaboration with Formela lab.

Contact: Matěj



# Blender addon or patch implementing [idea]

- **Background:** Blender is an open-source 3D modelling tool, extensible in Python.
- **Task:** Implement desired\* functionality, one of my suggestions, or your own idea.
  - Auto UV-stacking using graph isomorphisms (if you passed IB000 you'll be fine :))
  - Rearranging node materials in a readable layout (something like code formatting, but for nodes)
- Possibly suitable as **Bc thesis**

\*<https://blender.community/c/rightclickselect>



Contact: Filip

# Implement 3D Avatar responding to musical input



- **Background:** VTubers represent themselves in the virtual world using realtime avatars. Some of them like to play instruments.
- **Task:** Using any software, game engine or programming language, implement scene that has a Vtubing avatar that also responds when MIDI device sends in input. For example, avatar strikes a correct drum on a virtual drumkit in response to input from real electronic drumkit.
- Possibly suitable as **Bc thesis**

Contact: Filip

# Run the Stairs

- **Background:** In Rosice, open-air stairs are used for “run the stairs challenge.” *What if* an online tool or app allows anyone to measure their climbing time (and possibly track the progress)?
- **Task:** Design and develop a gamified system that will be self-operated. Evaluate its usability.
- **Deliverable:** A working prototype implementation.
- **Note:** Extendable to *Bc/Mgr thesis*
- **Tags:** #HCI #gamification #fitness



[Source](#)

Contact: Vítek

# Improve Usable Security for Windows Users

- **Background:** [Paretto](#) is a simple auditing tool that helps to improve the cybersecurity protection of macOS.
- **Task:** Let's find out similar measures for Windows and implement a prototype tool with security tips for users.
- **Deliverable:** A working prototype implementation.
- **Note:** Extendable to *Bc/Mgr thesis*
- **Tags:** #HCI #UsableSecurity



Contact: Vítek



# Interactive Display Wall

- **Background:** SAGE3 is the latest collaborative middleware for High-resolution Scalable Displays (HRSDs) a.k.a display-walls. There is one HRSD at KYPO Lab and we would like to use it for collaboration and teaching.
- **Task:** Get familiar with SAGE3 middleware, and the display wall in the KYPO laboratory. Deploy SAGE3, optimize (configure the system), benchmark the performance and perform small-scale user study focused on co-located collaboration of several users.
- Extendable to **Bc/Mgr thesis**
- **Tags:** #CSCW, #HRSD, #SAGE3



Contact: Vítek

# Hands-on Activities for HCI Class

- **Background:** In PV182, we are introducing students into the HCI field. To make the lectures more engaging, we would like to add few interactive exercises.
- **Tasks:** Choose, design and develop a set of online/offline activities.
- **Deliverable:** Set of activities.
- **Note:** Extendable to *Bc/Mgr thesis*
- **Tags:** #HCI #gamification #education

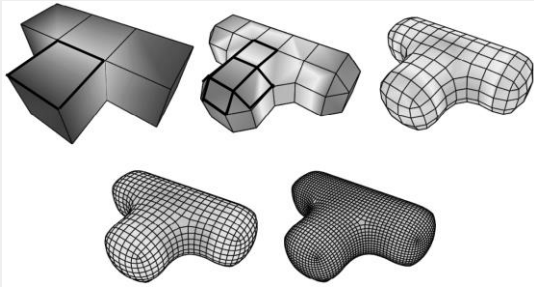


[Source](#)

Contact: Vitek & Simone

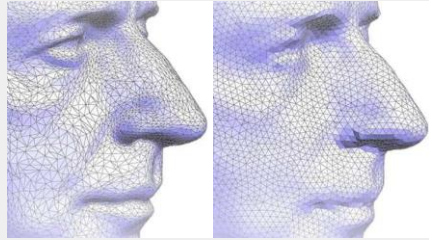
# Practical Assignments for PA010

- Assignment = task implementation in C++ framework.
- Available tasks:

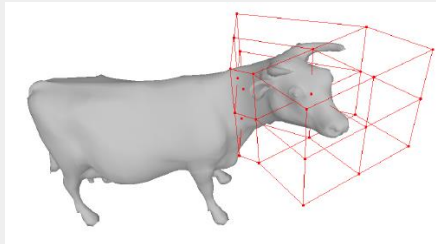


Doo-Sabin Subdivision

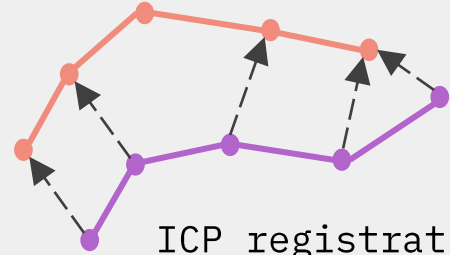
And more...



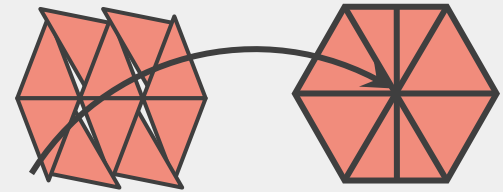
Mesh regularization



Mesh deformation



ICP registration



Edge collapse simplification

Contact: Marek, Jan, Katka

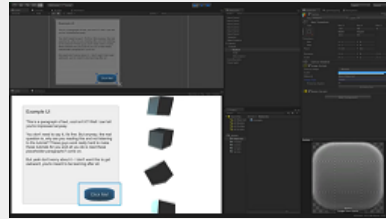
# Tutorials for Game Development Seminars (PV255)

- Prepare interesting teaching materials for a particular GameDev topic.
- Output: Tutorial document and implementation in Unity.
- Available topics:

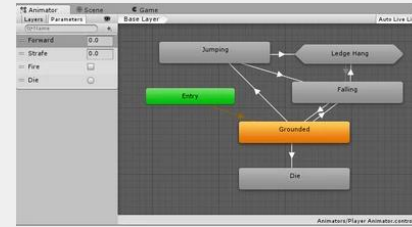


Networking

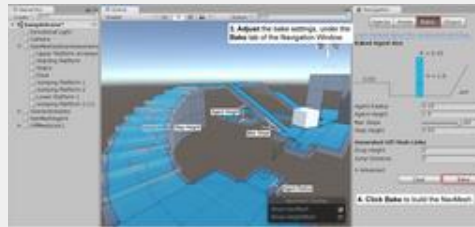
And more...



User interface



Character animation



Navigation mesh

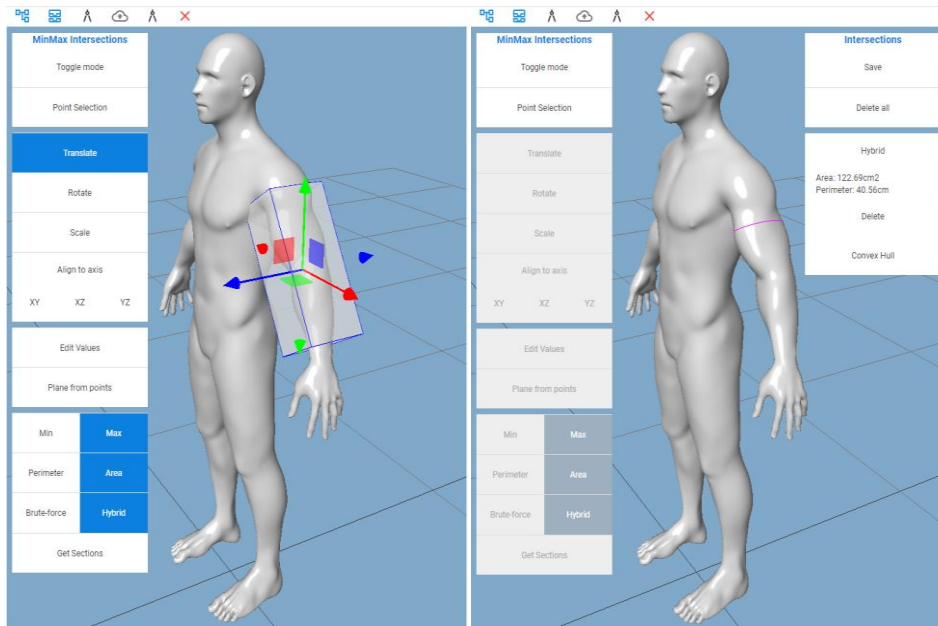


Physics

Contact: Jirka, Marek

# A.D.A.P.T. – Antropologická DAtabáze Proporcí Těla

- **Available tasks:**
  - Add orthographic projection.
  - Show coordinates of point under the mouse.
  - Major and minor axis of a selected geometry.
  - Improve user's interaction with the tool.
  - ...
- Implementation language:
  - JavaScript



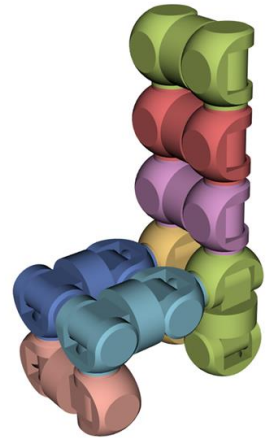
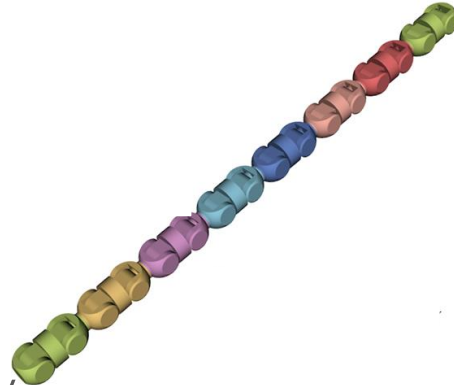
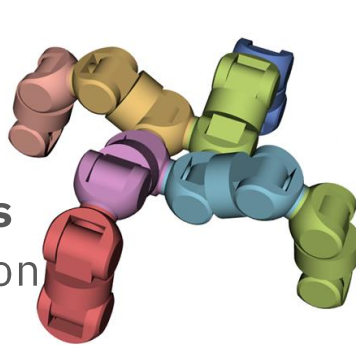
# 3D editor of RoFIbots

## Goal of the project

- To implement 3D(+VR?) editor of RoFIbot configurations
- RoFIbots made of individual universal modules – building blocks
- Universal modules
  - Three rotational joints
  - Six connectors

## Application requirements

- Save/Load configuration
- (extra) Image export
- (extra) Optionally turn on the gravity
- (extra) Parametric rigidity of joints
- Make a stand alone application



Contact: Jiří, Marek

# 3D text rendering in WebGPU

#web #webgpu #biological visualization

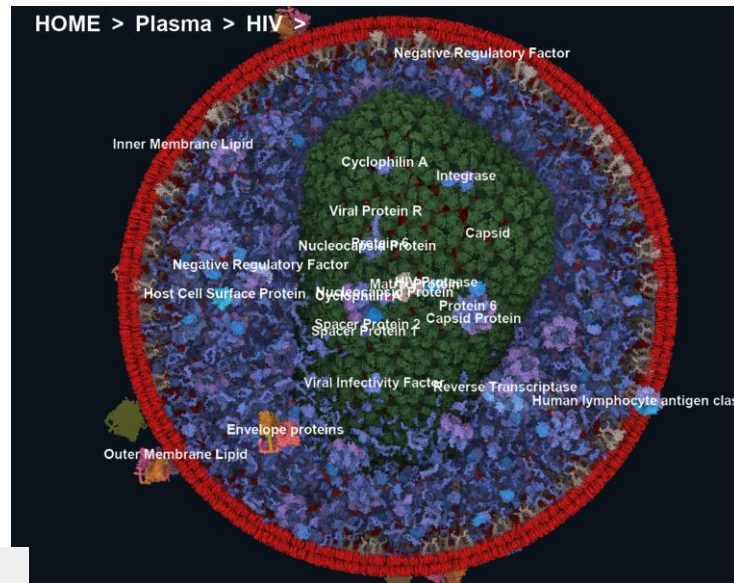
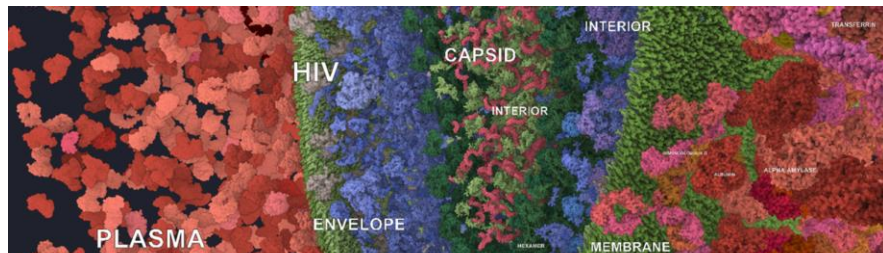
- Drawing arbitrary texts as billboards in 3D space



(a) High resolution input



(b) 64x64 Distance field



Contact: Matúš Talčík, David Kouřil

# Spline Rendering using High-Performance Polynomial Solver

#web #webgpu #math #bezier #hair

- Polynomial solver is already open-source (C++)
- Drawing bezier curves
- **TypeScript** CPU implementation
- **WGSL Shader**
- **Benchmark** application



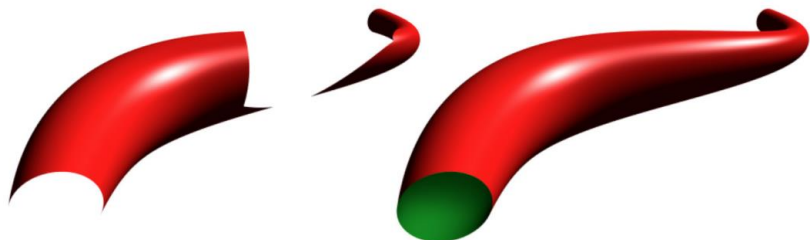
## High-Performance Polynomial Root Finding for Graphics

CEM YUKSEL, University of Utah, USA

We present a computationally-efficient and numerically-robust algorithm for finding real roots of polynomials. It begins with determining the intervals where the given polynomial is monotonic. Then, it performs a robust variant of Newton iterations to find the real root within each interval, providing fast and guaranteed convergence and satisfying the given error bound, as permitted by the numerical precision used.

For cubic polynomials, the algorithm is more accurate and faster than both the analytical solution and directly applying Newton iterations. It trivially extends to polynomials with arbitrary degrees, but it is limited to finding the real roots only and has quadratic worst-case complexity in terms of the polynomial's degree.

We show that our method outperforms alternative polynomial solutions we tested up to degree 20. We also present an example rendering application with a known efficient numerical solution and show that our method provides faster, more accurate, and more robust solutions by solving polynomials of degree 10.



(a) *Phantom Ray-Hair Intersector*

(b) *Ours with 64-bit precision*

Contact: Matúš Talčík

ACM Reference Format:

Cem Yuksel. 2022. High-Performance Polynomial Root Finding for Graphics. *Proc. ACM Comput. Graph.*



# Course Structure Representation for BioMedVis Platform

- **Task:** Create a visual representation of the course hierarchy (prerequisites & advanced courses) and learning progress for an e-learning platform.



Contact: Katka & Hana

# Scientific Trends Dashboard

- **Task:** Create a dashboard to show the evolution, relationships and trends, with regard to publications within the biomedical visualization community.
- **Requirements**
  - Web-based application (D3, JavaScript)
  - Interest in visualization and visual analytics
  - Good programming skills

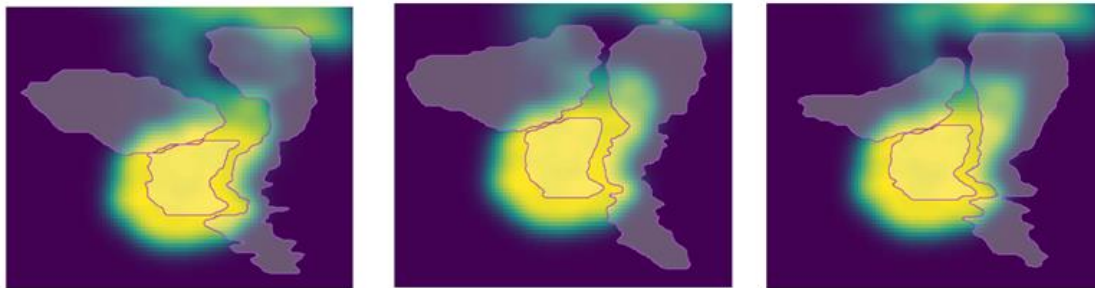
[More information here](#)

Contact: Katka & Bara



# Organ Motion Analysis for Radiotherapy

- **Task:** Improving methods for organ motion prediction and analysis for radiotherapy.
  - Improve shape clustering speed.
  - Average mesh computation.
  - Integrate new method of motion description into existing predictive model and compare the existing and new method.
- **Requirements**
  - Good programming skills (Java).



Contact: Katka

# Contacts:

- David = David Kuťák [kutak@mail.muni.cz](mailto:kutak@mail.muni.cz)
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# Requests for participation in the user studies

Within the semester, we will bother you with few requests for taking part of our user studies

Please, help us and follow them :)

There will be at least one from Matěj and one from David Kuťák

# Questions?

Now it's time for your questions, comments, own topics, and individual discussions with supervisors of individual topics ...

Deadline for choosing a topic - including discussion with supervisor:

**Friday Sept 23**