Social Virtual Reality

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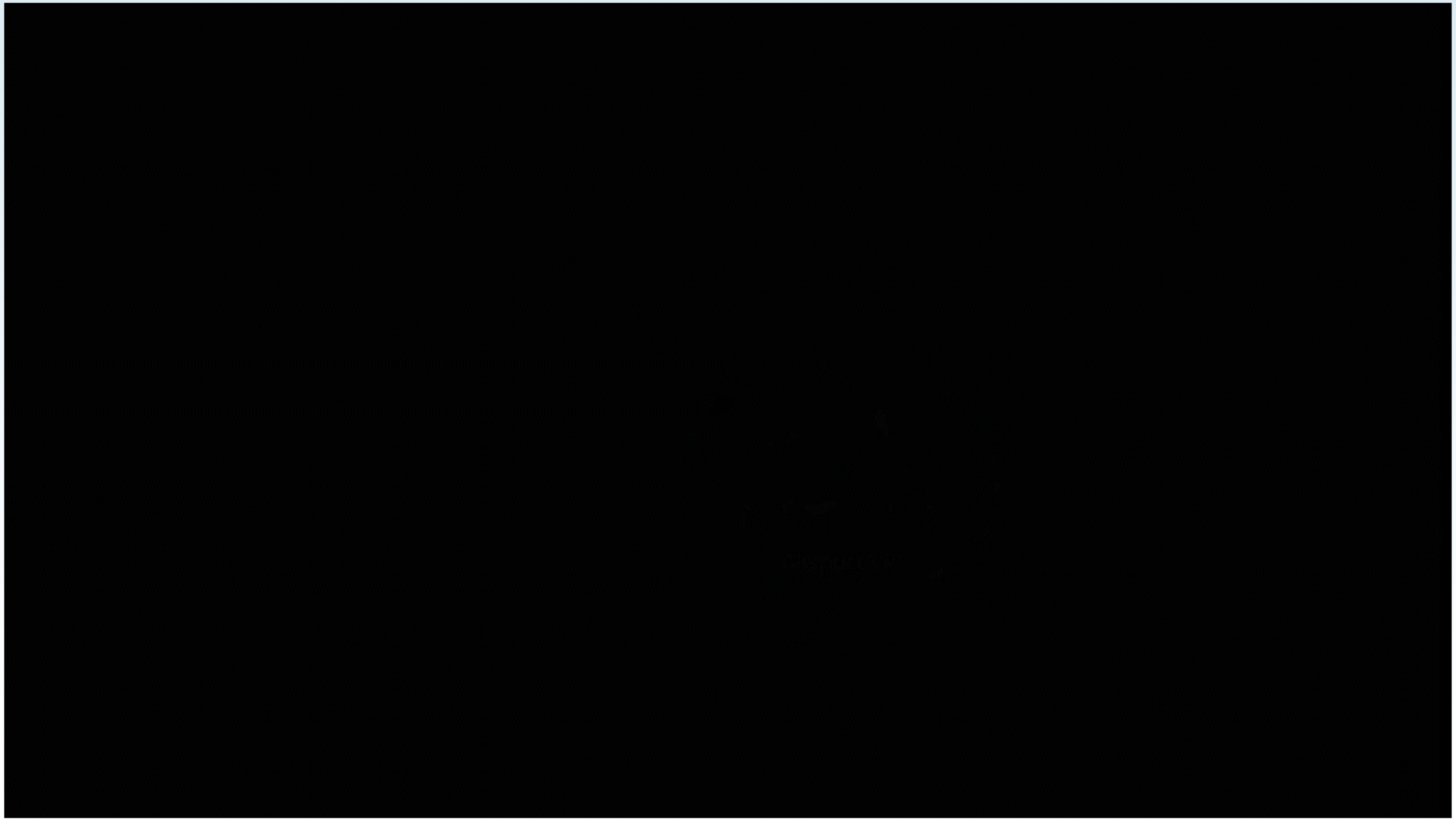
Overview

- Social Virtual Reality
- Making Avatars
- Avatars and Immersive Collaboration
- Realism and the Uncanny Valley

SOCIAL VIRTUAL REALITY

AltspaceVR (RIP)



The Under Presents

https://www.youtube.com/watch?v=-KMmJBnMXtw

Avatars in Shared Virtual environments

- Perception (to see if anyone is around)
- Localisation (to see where the other person is)
- Identification (to recognise the person)
- Visualisation of others' interest focus (to see where the person's attention is directed)
- Visualisation of others' actions (to see what the other person is doing and what is meant through gestures)
- Social representation of self through decoration of the avatar (to know what the other participants' task or status is)

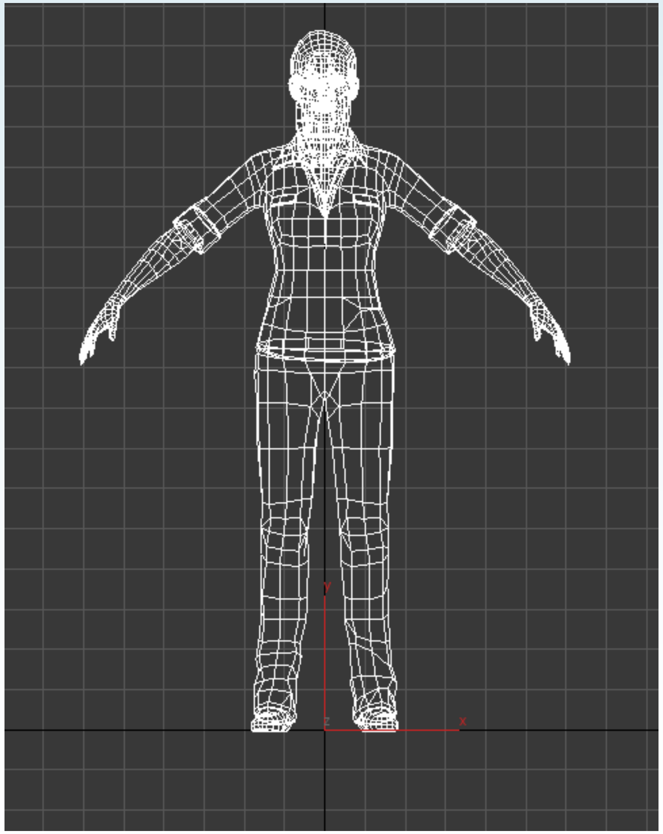
MAKING AVATARS

Making Avatars & Virtual Characters

- Mesh (geometry)
- Textures (appearance)
- Skeleton (structure)
- Skinning (attaching mesh to skeleton)
- Rigging (controls for the skeleton)
- Animation (animating the skeleton)
- Faces (with blend shapes or bones)

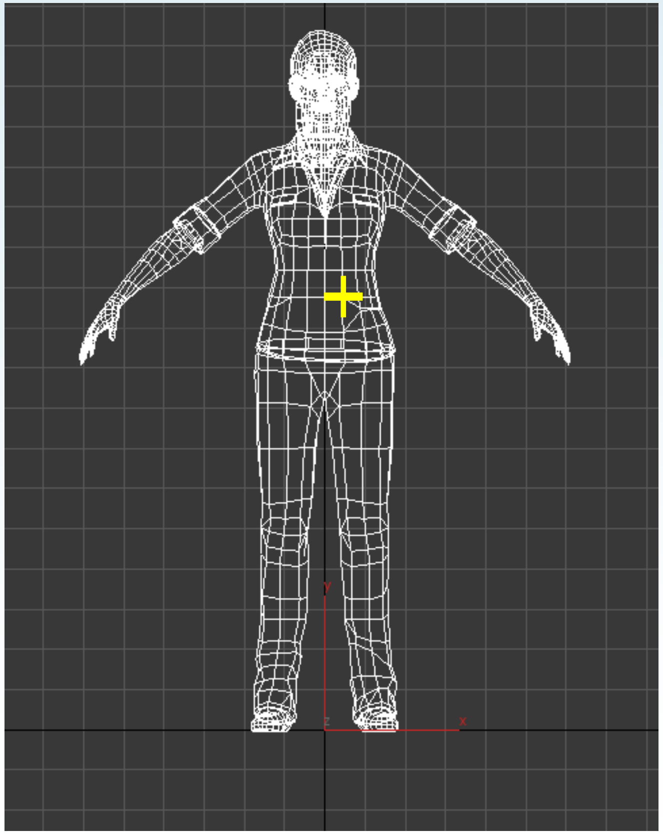
https://github.com/microsoft/Microsoft-Rocketbox

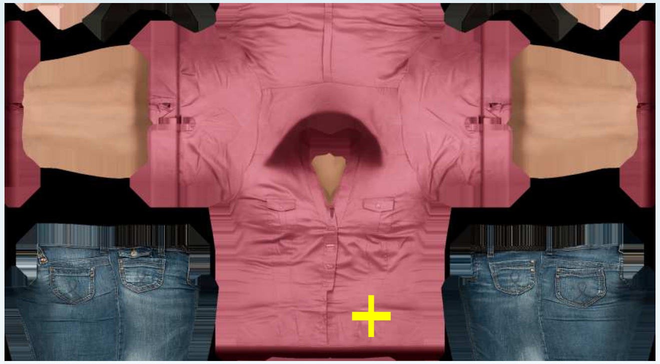
Mesh Construction (Set of polygons)

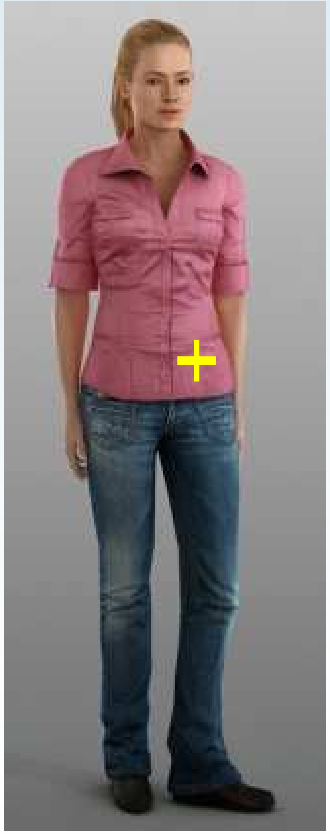


Texture (Set of texture maps)

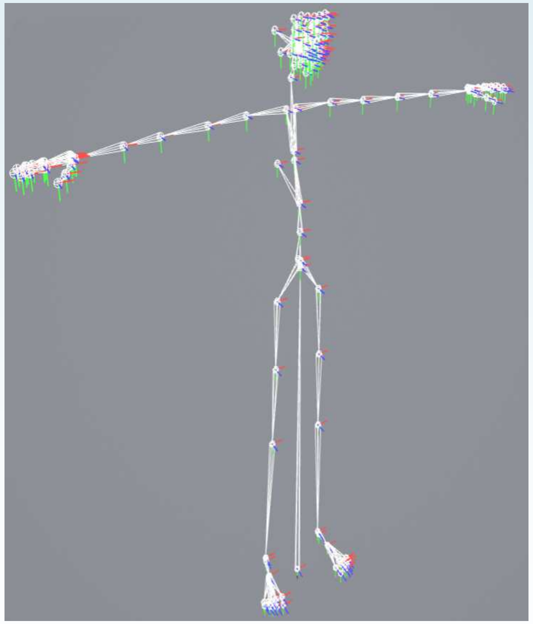
UV Maps



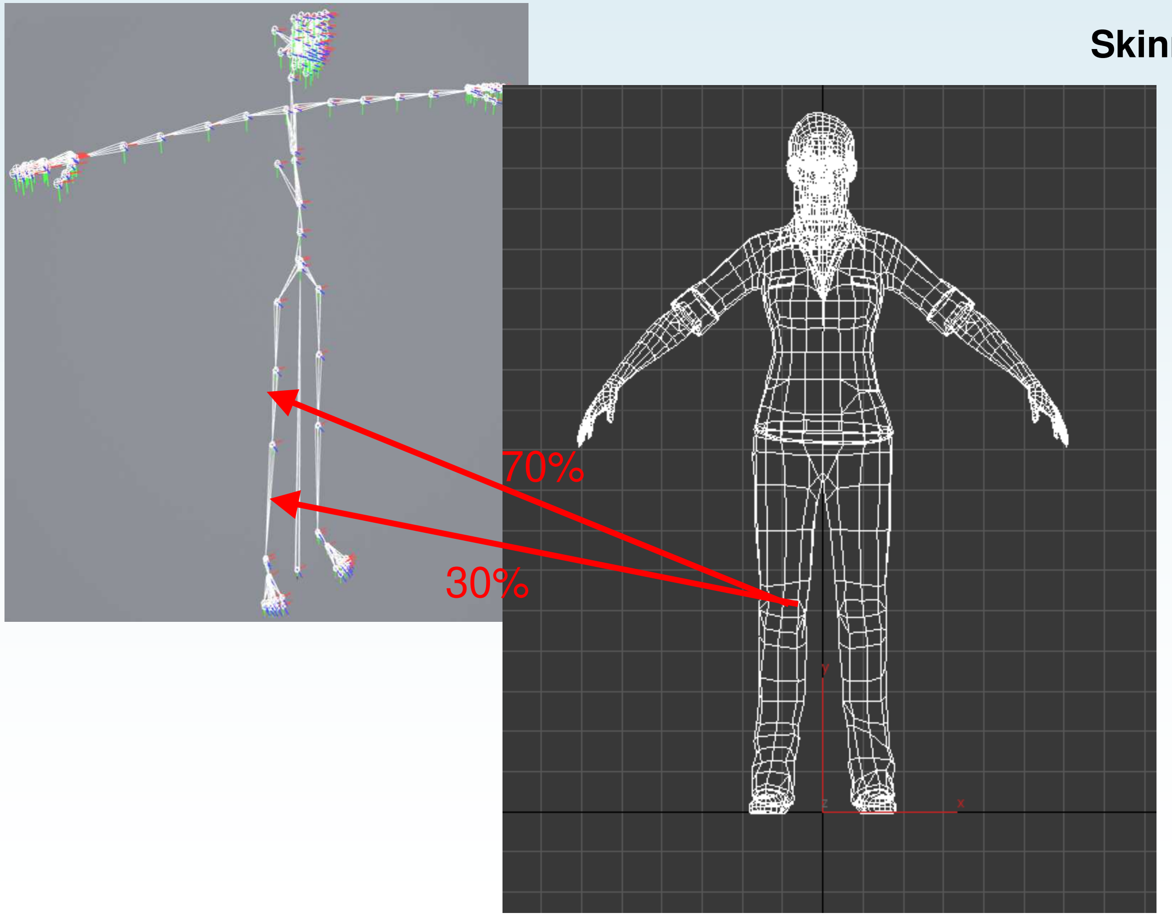




Skeleton (List of transforms)



Skinning (List of weights for each vertex to bones)

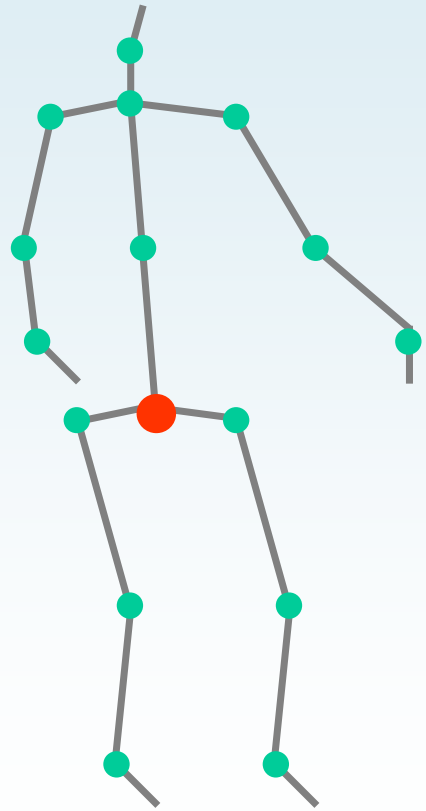


Skinning

Rigging

- Rigging is the process of creating, augmenting and constraining the skeleton of a 3D model so it can be animated.
- Rigging can introduce specialised bones, *controls*, that do not move the mesh directly but drive movement in:
    1. one or more skeletal bones
    2. morph targets (vertex animation – see later);
    3. material/texture map changes (wrinkle maps etc.) or
    4. other rig control bones (twist and stretch bones).
- Rigging is used for both real-time and off-line animation but tends to be more complex for the latter.

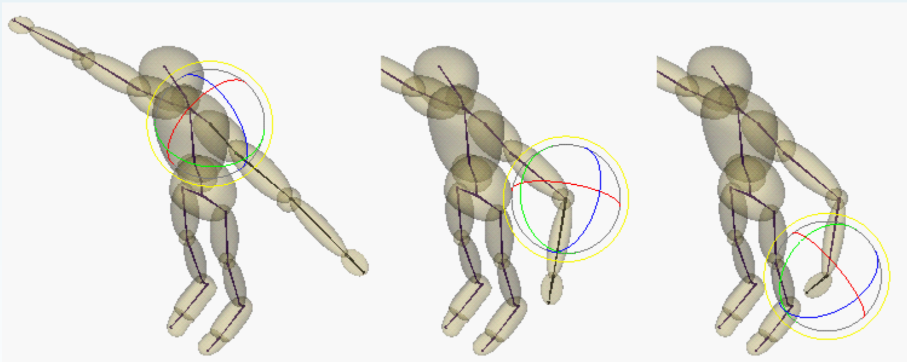
Animating Avatars & Virtual Characters



- Circles are rotational joints, lines are rigid links (bones).
- The red circle is the root (defines the position and orientation of the character).
- The character is animated by rotating joints (3 parameters) and moving and rotating the root (6 parameters) in a standard BVH file format skeleton.

Forward Kinematics

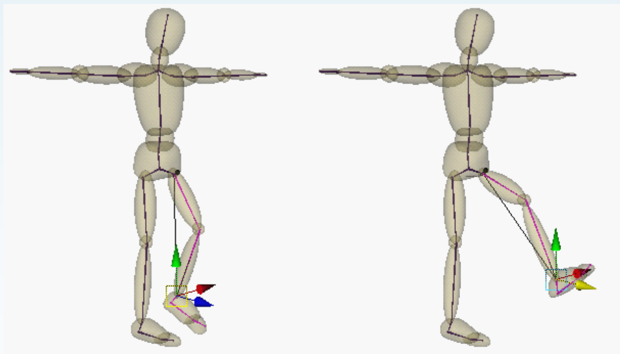
- Forward Kinematics (FK): the animator specifies rotation parameters at each joints, usually working from parent to child joints.



- Pros: simple and intuitive for certain animation, good for tweaking
- Cons: getting the figure to a desired position can be difficult for more complex animation

Inverse Kinematics

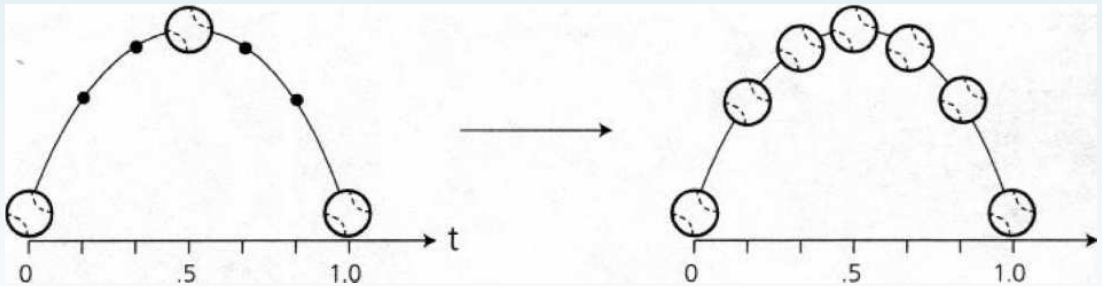
- The position of the ‘end effector’ (e.g. hand or foot) is specified. New rotations of a specified number of bone joints “up the chain” are calculated



- Pros: fast and intuitive to use even on complex animations
- Cons: not always very natural looking as under-constrained

Character Animation

1. Traditional key-frame animation, by hand and the computer interpolates ('tweens')



2. Motion capture clips 'strung together' using simple interpolation via *motion graphs*
3. Procedurally generated animations using physics engines or newer machine learning techniques etc.

Phase-Functioned Neural Networks for Character Control

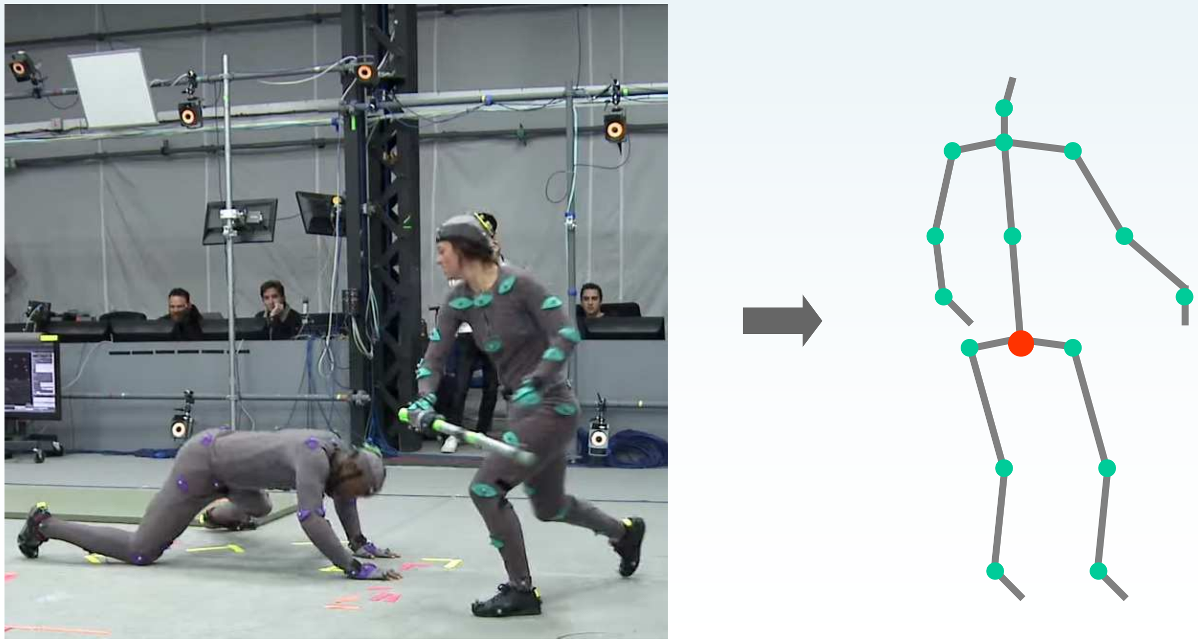
Daniel Holden [1], Taku Komura [1], Jun Saito [2]

[1] University of Edinburgh, [2] Method Studios

Holden, Daniel, Taku Komura, and Jun Saito. "Phase-functioned neural networks for character control." *ACM Transactions on Graphics (TOG)* 36.4 (2017): 42.

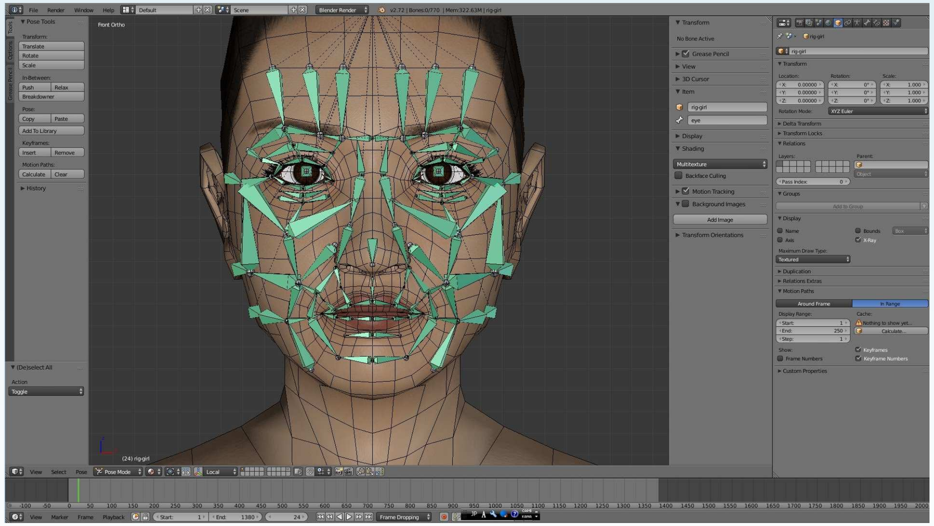
Motion Capture

- Capture an animation by tracking a real human
- Many tracking technologies, see next week, but optical is common for motion capture



Bone-based methods

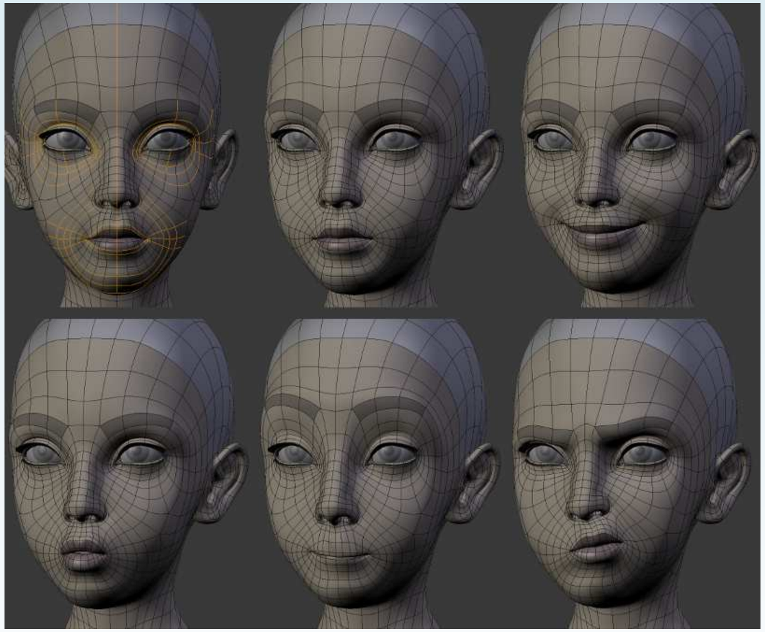
Similar to bones in body animation



Each bone affects a number of vertices with weights in a similar way to skinning for body animation.

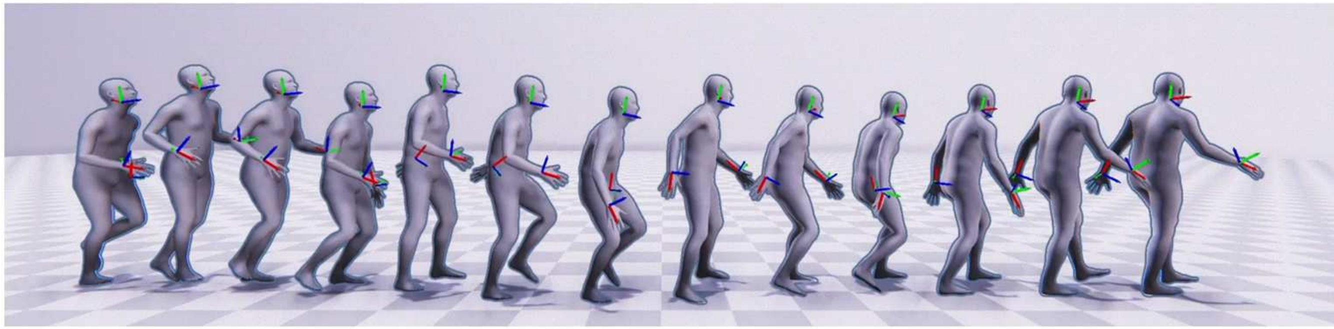
Shape interpolation methods

- aka. morph targets, blend shapes, shape keys etc.
- Starts with a base ‘neutral’ expression
- Get six (or more) extreme expression
- Build new facial expression blends out of these basic expressions simply by taking weight average of the seven (or more) base meshes



Tracking from Low Dimension Input

Avatars Grow Legs (AGRoL) : Generating Smooth Human Motion from Sparse Tracking Inputs with Diffusion Model

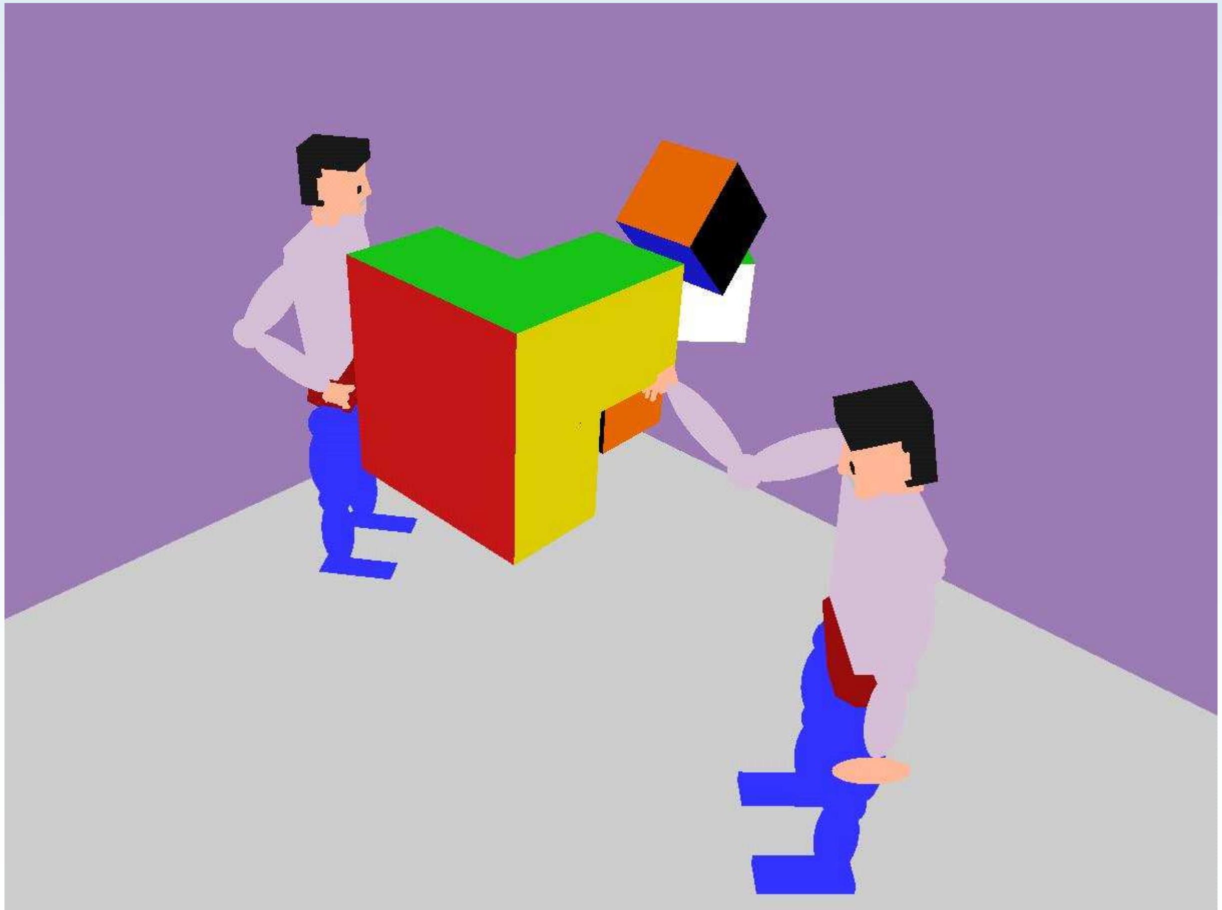


Yuming Du, Robin Kips, Albert Pumarola, Sebastian Starke, Ali Thabet, Artsiom Sanakoyeu
Meta AI

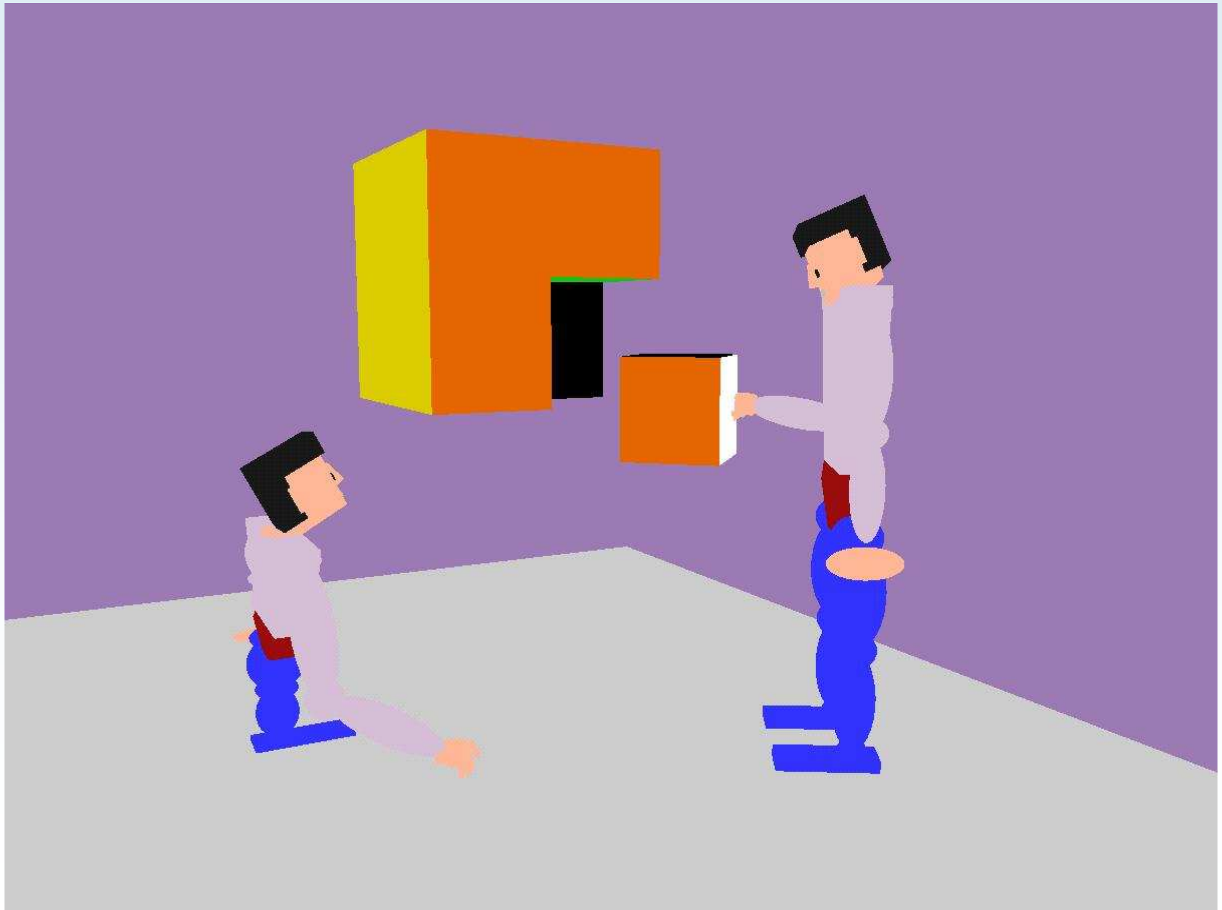
https://dulucas.github.io/agrol/

AVATARS AND IMMERSIVE COLLABORATION

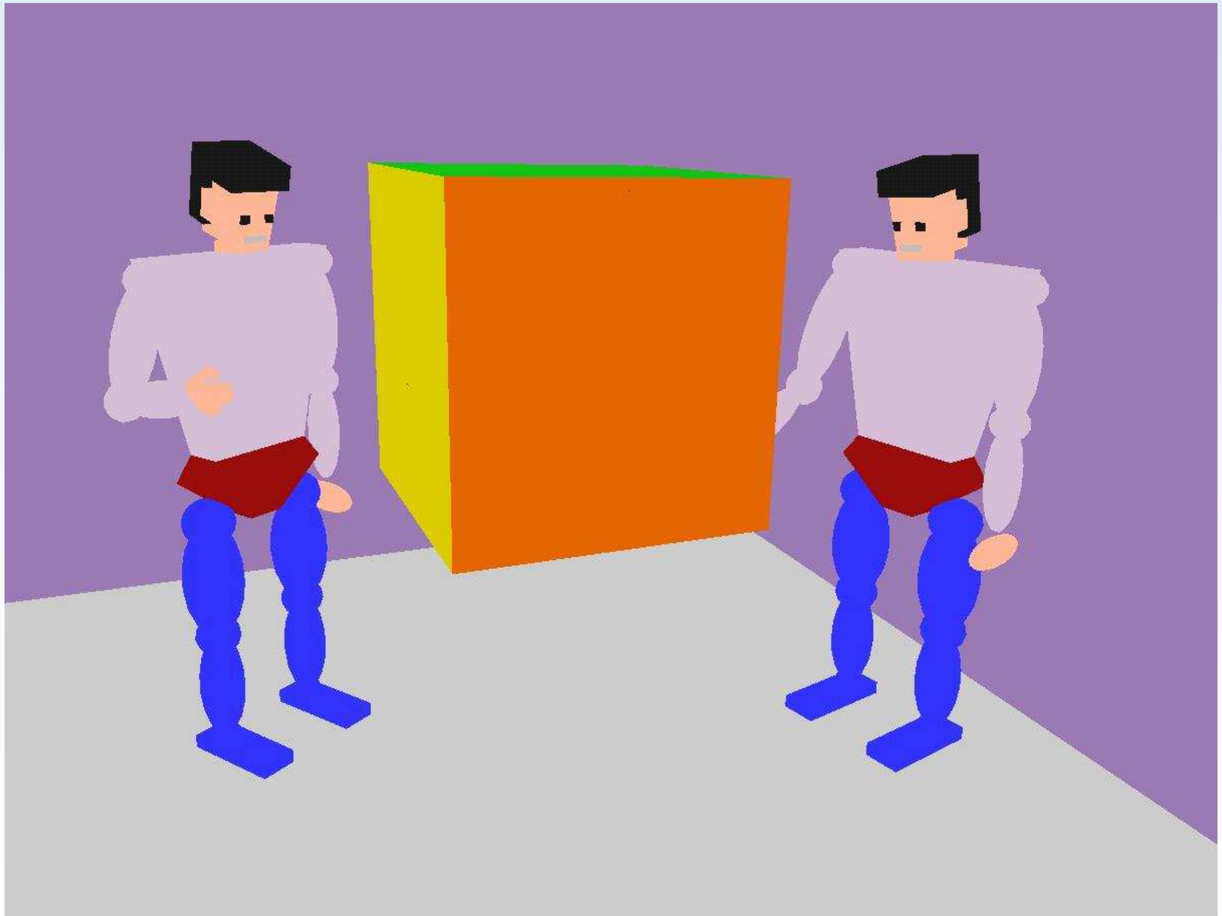
Cubes in the Cube



Cubes in the Cube



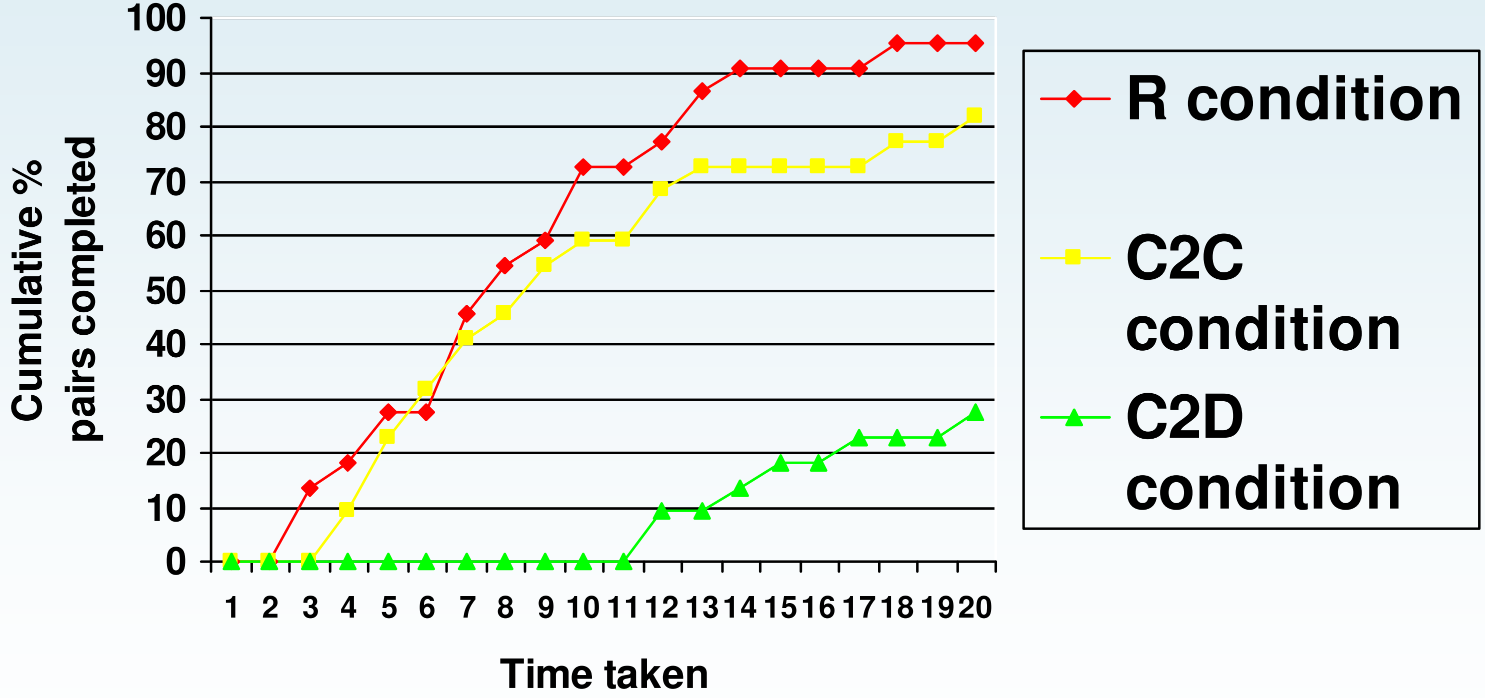
Cubes in the Cube



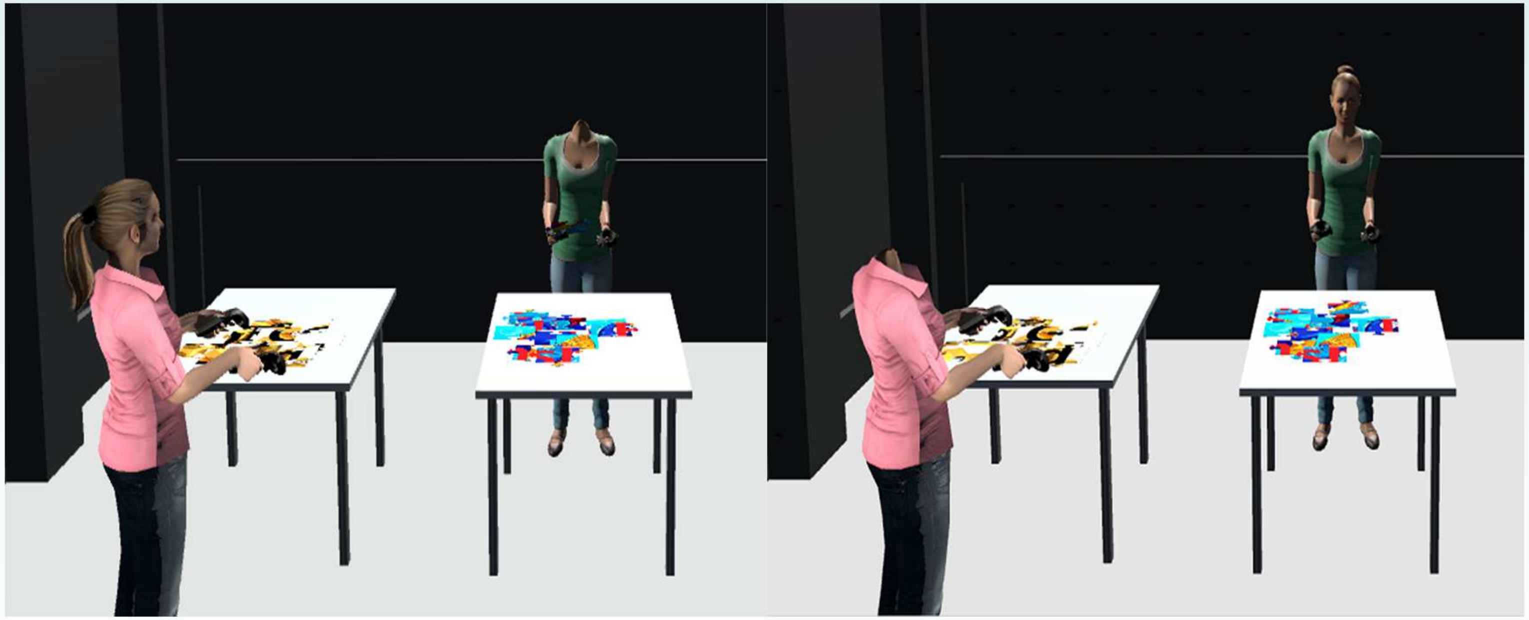
Cubes in the Cube

- Two immersed participants could collaborate fluidly
- One immersed and one desktop user had more problems and did the task(s) differently
- The main task involves splitting the solution in to multiple stages, allocating them to each other, monitoring, etc.

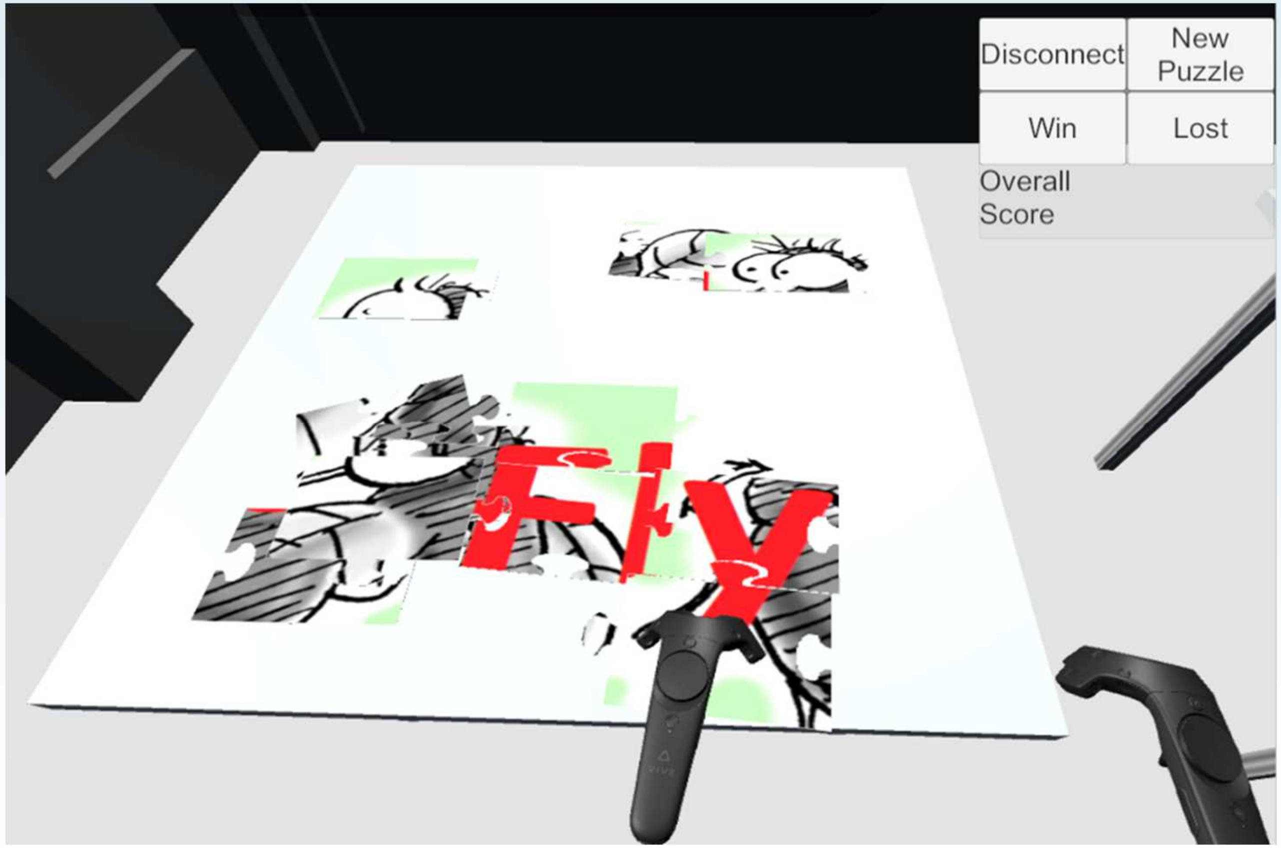
Results - Completion Rates



Behaviour

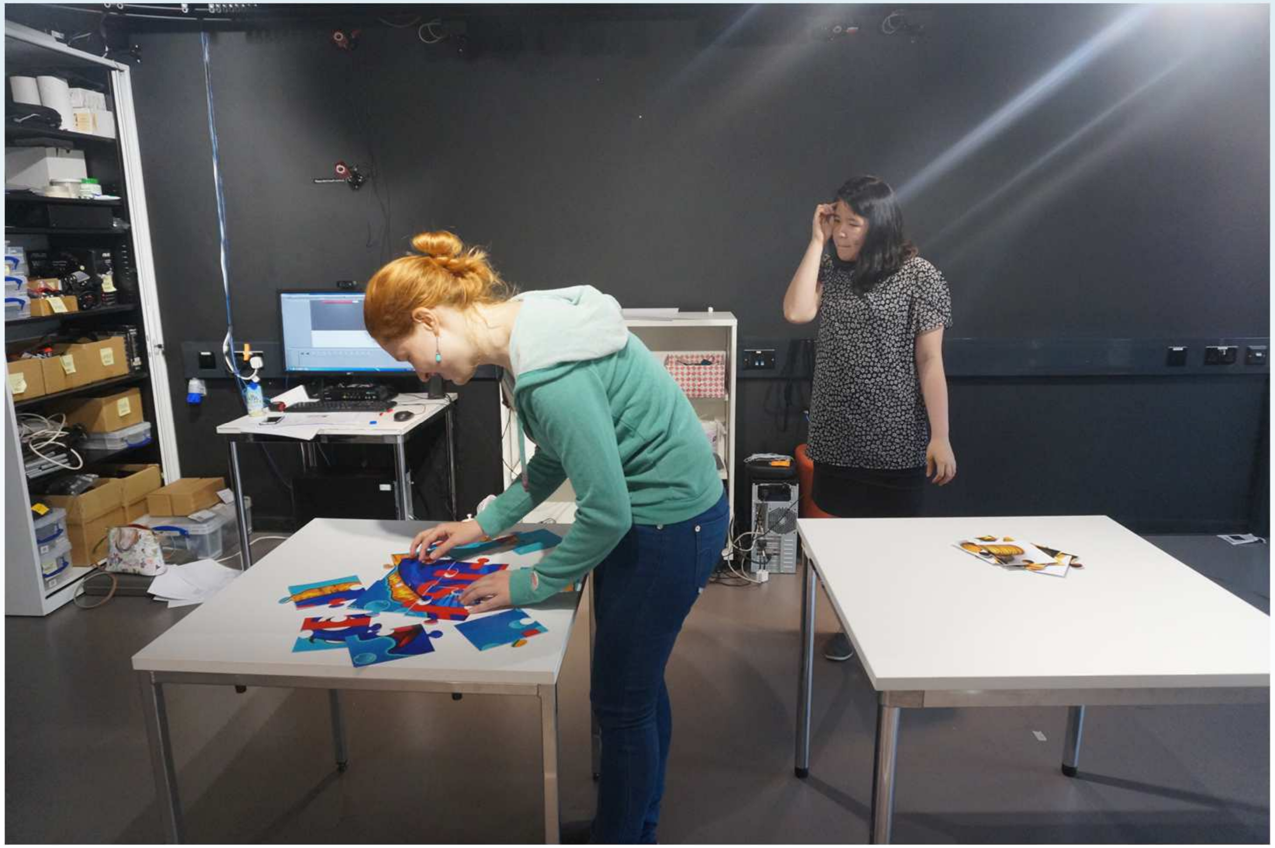


Behaviour



Behaviour

Behaviour



Behaviour

A Longitudinal Study of Small Group Interaction in Social Virtual Reality

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ABSTRACT
Now that high-end consumer phones can support immersive virtual reality, we ask whether social virtual reality is a promising medium for supporting distributed groups of users. We undertook an exploratory in-the-wild study using Samsung Gear VR headsets to see how existing social groups that had become geographically dispersed could use VR for collaborative activities. The study showed a strong propensity for users to feel present and engaged with group members. Users were able to bring group behaviors into the virtual world. To overcome some technical limitations, they had to create novel forms of interaction. Overall, the study found that users experience a range of emotional states in VR that are broadly similar to those that they would experience face-to-face in the same groups. The study highlights the transferability of existing social group dynamics in VR interactions but suggests that more work would need to be done on avatar representations to support some intimate conversations.

CCS CONCEPTS
• **Human-centered computing → Virtual reality; Computer supported cooperative work;**

KEYWORDS
Virtual reality; social VR; avatar representation; affective states; in-the-wild study

ACM Reference Format:
Fares Moustafa and Anthony Steed. 2018. A Longitudinal Study of Small Group Interaction in Social Virtual Reality. In *VRST 2018: 24th ACM Symposium on Virtual Reality Software and Technology (VRST '18), November 28-December 1, 2018, Tokyo, Japan.* ACM, New York, NY, USA, 10 pages. https://doi.org/10.1145/3281505.3281527

1 INTRODUCTION
The past couple of years have seen virtual reality reach the consumer market in a significant way. While a lot of attention has been paid to the high-end desktop PC-based systems, devices such as Samsung Gear VR and Google Daydream, which convert a high-end smartphone into a head-mounted display, are now a viable platform for more complex immersive virtual reality environments. Given that manufacturer's flagship smartphones tend to ship millions of units, such systems are bringing immersive VR to a broad and diverse audience. In particular, as devices become more popular, they may become a viable medium to support collaboration at a distance.

Gaming and social platforms have used non-immersive virtual environments for many years. Certain platforms such as World of Warcraft and Second Life have supported long-lived communities that have been studied from a variety of viewpoints. Certainly, very strong social relationships are formed and maintained on such platforms. However, such platforms have a certain barrier to entry. The form of technology, difficulty of use, or story-based settings have meant that whilst popular, they are not broadly used for social communication. Immersive virtual reality has new affordances over such systems. Whilst social interaction has been studied on immersive systems, this has typically been in a laboratory setting.

In this paper, we describe an exploratory in-the-wild study on the use of immersive virtual reality to support social groups. We are particularly interested in supporting existing groups: thereby we can investigate how groups might migrate to use immersive virtual reality as a collaborative medium as an alternative to voice, picture or text messaging. Participants in our study used social environments on the Samsung Gear VR over an extended period. Through diary studies, quantitative measures and interviews, we explored how they adapt to and use the systems.

The following section will cover the existing literature on how interpersonal relationships are created between people, and the way in which technology has previously supported this type of behaviour. We review current research into the effects avatars have on communication between users in virtual environments, and the way in which relationships can develop between users and avatars. This will provide a basis of contextual understanding that can then be applied to scenarios in VR, as well as act as a basis of comparison between the various technologies. Then, an in-the-wild exploratory study is conducted to gather data on how real users engage with their familiars remotely in VR. We use principles outlined in Grounded Theory [6, 15] to analyse the results and discuss how VR can be used as a platform to promote the development of interpersonal relationships.

2 RELATED WORK
A great deal of previous research into interpersonal relationships has focused on the importance nonverbal communication plays in human interaction [1, 5, 16]. Steve Duck [10] states that "You cannot utter a word without also simultaneously indicating how you

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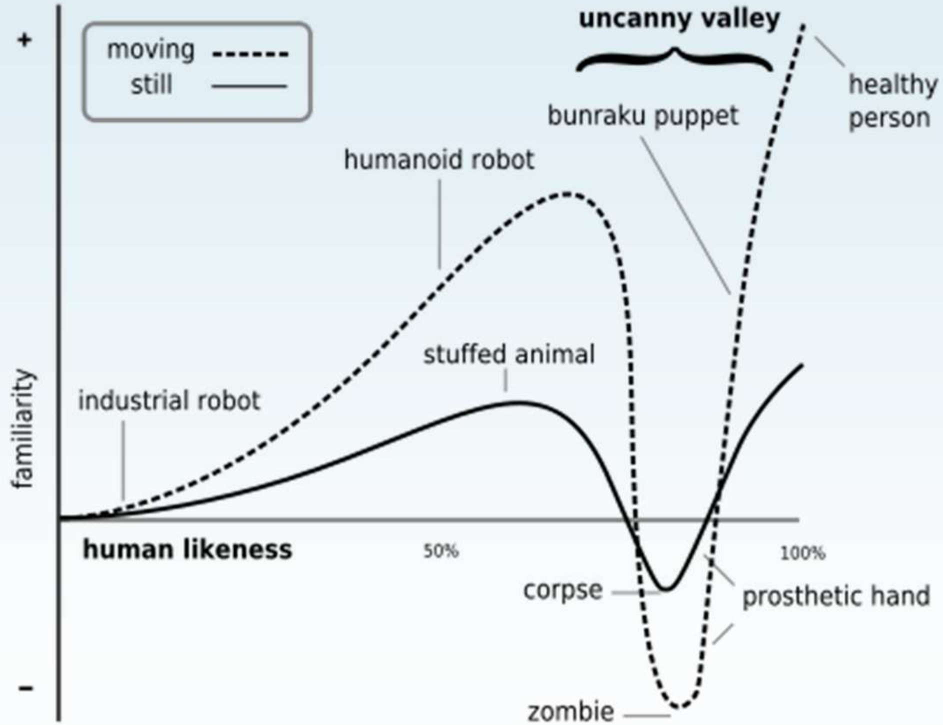
REALISM AND THE UNCANNY VALLEY

Facebook Codec Avatars

https://tech.fb.com/codec-avatars-facebook-reality-labs/

Facebook Codec Avatars

Uncanny valley



M. Mori, "The uncanny valley", *Energy*, vol. 7, no. 4, pp. 33-35, 1970

Summary

- Social VR has been around almost as long as VR
- While non-verbal behavior is communicated fluently, the systems have the capability to filter and change meaning
- People can behave in immersive systems, much like they do in reality
  – However technical limitations exist, especially around faces
- Realism may be self-defeating as although it conveys identity, there is a problem with the uncanny valley