Simulator Sickness

DOM-E5161 - Introduction to Virtual Reality

Markku Reunanen

Simulator sickness?

Nausea caused by VR use, at times called *cybersickness*

Not the same as motion sickness, even if overlapping

Polygenetic and polysymptomatic

Serious issue affecting users' wellbeing and enjoyment

Observed already in the late 1950s' in a helicopter simulator

Simulator sickness?

About 10–15% of users particularly susceptible to simulator sickness

Eugenia M. Kolasinski (1995): *Simulator Sickness in Virtual Environments*

Own experiences at the Tampere Virtual Reality Center:

- HMD/screen switching
- Visitors' and workers' nausea and postural instability
- Pilots are tough guys :)

Symptoms

- General discomfort, nausea
- Stomach awareness
- Headache, eye strain
- Sweating, salivation
- Dizziness, postural sway
- Ataxia
- Disorientation
- Even flashbacks have been observed

Causes: user, simulator and task related

age	binocular viewing	altitude above terrain
concentration	calibration	degree of control
ethnicity	color	duration
experience with real-world task	contrast	global visual flow
experience with simulator, adaptation	field of view	head movements
flicker fusion frequency treshold	flicker	luminance level
gender	inter-pupillary distance	method of movement
illness and personal charas-teristics	motion platform	self-movement speed
mental rotation ability	phosphor lag	type of application
perceptual style	position tracker error	unusual maneuvers
postural stability	refresh rate	vection
	resolution	sitting vs. standing
	scene content	rate of linear or rotational ac-celeration
	time delay	
	update rate	
	viewing region	

Theories

Casali's *Cue conflict theory* (1986) the most common

Stoffregen and Riccio's *Postural instability theory* (1991)

Treisman's *Evolutionary* or *Poison theory* (1977)

None of them can explain all the situations reliably

Measuring simulator sickness

Simulator Sickness Questionnaire (SSQ) – subjective measurement

RSSQ a modified version of the above

Postural sway measurements

Eye-hand coordination tests

Optimally measured before, right after and possibly multiple times later after exposure

SSQ

	none	*slight*	*moderate*	*severe*
general discomfort	☐	☐	☐	☐
stomach awareness (unusual feeling in the stomach)	☐	☐	☐	☐
nausea	☐	☐	☐	☐
burping	☐	☐	☐	☐
headache	☐	☐	☐	☐
dizzy, eyes closed	☐	☐	☐	☐
dizzy, eyes open	☐	☐	☐	☐
imaginary feeling of movement (feel like you're moving, when you're not)	☐	☐	☐	☐
fatigue	☐	☐	☐	☐
eye strain	☐	☐	☐	☐
difficulty focusing	☐	☐	☐	☐
blurred vision	☐	☐	☐	☐
fullness of head	☐	☐	☐	☐
difficulty concentrating	☐	☐	☐	☐
sweating	☐	☐	☐	☐
increased salivation	☐	☐	☐	☐

What can we do?

Limit simulator use time (<1 hour), start easy

Have a stable chair nearby, don't leave users unattended

Ensure good air quality

Encourage positive and relaxed attitude

Seated vs. standing user

Avoid big meals, alcohol and smoking before use

What can we do?

Avoid sudden acceleration and deceleration

Avoid sudden turns

Minimize visual flow when possible (attempts with noise)

Teleportation vs. flying, altitude

Avoid constant adaptation back and forth

Help users to predict forthcoming motion (pointers, avatars, paths)

What can we do?

Offer a stable *rest frame*

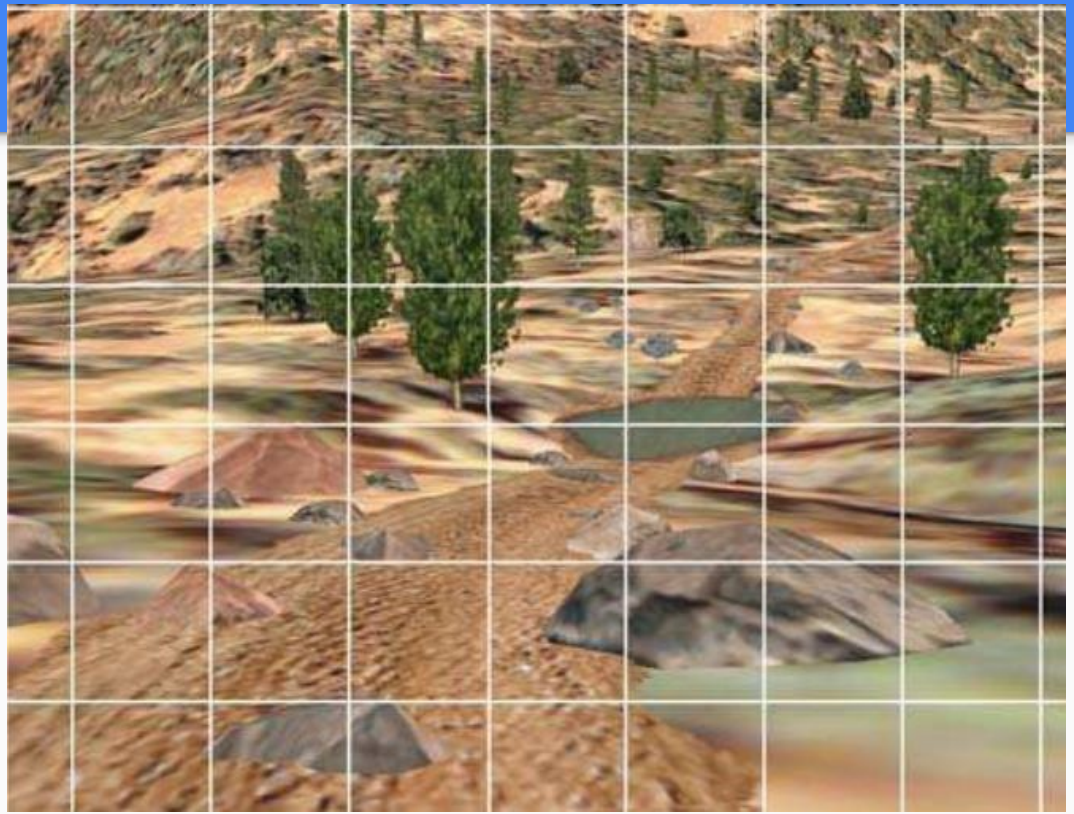
- Real-world frames and other objects
- Virtual nose(!)
- Grid

Visual off when entering and leaving

Consider whether stereoscopic graphics are necessary

Medical solutions? (motion sickness medicine, ginger)

A possible rest frame



C'est ça!

Next up: instructions for the exam and wrapping up the course

UWAS-C0056 *Designing and Creating Virtual Worlds*