UDESC CCT – PPGEEL – Joinville – maio/2025
TECT - RAV: Realidade Aumentada e Virtual

Video-See-through HMDs / Canetas

Breve análise

Luis Alfredo da Silva

luisalfredodasilva@gmail.com

XR

Hoje analisaremos 2 categorias de produtos:

- **HMDs** com *video-see-through (VST);*
- **“Canetas”**

HMD com video-see-through;

Dispositivo de *saída** para XR que **substitui** a visão de mundo do usuário, **contendo câmera**(s) que permitem **replicar** e **alterar** a visão do mundo real.

- **Não é** translúcido.

*Controles, etc. não serão analisados.

Características analisadas – HMD

- **Display**
  - tecnologia/layout subpixel/**PPD**/Hz;
- **Lentes**:
  - FoV H/V; Ajuste de **IPD**;
- **Câmera(s)**;
- **Tipo** (*standalone* / PC);
- **Peso**;
- **Disponibilidade** oficial no Brasil;

História

1. Óculos VR qualquer com câmera *externa* acoplada;
2. **HTC Vive *(2016):*** *passthrough* preto-e-branco, 2D;
3. **Lenovo Mirage SOLO *(2018):*** custo reduzido;
4. **Quest 3 *(2023):*** *passthrough* colorido, estéreo, 18 PPD;
5. **Varjo XR-4 Focal *(2024)***: 51 PPD, *$$$$$*;

Opções – HMD Video-see-through

	HTC **Vive**	Lenovo **Mirage Solo**	Apple **Vision Pro**	Meta **Quest 3**	Meta **Quest 3S**	Varjo **XR-4 Focal**
Lançamento	2016	2018	2023	2023	2024	2024
Display	1080x1200 90Hz PenTile OLED	1280x1440 75Hz RGB LCD	**3660x3200** 100Hz RGB µOLED 34 PPD	**2064x2208** **120Hz** RGB LCD 25 PPD	**1832x1920** **120Hz** RGB LCD 20 PPD	**3840x3744** 90Hz RGB miniLED **51** PPD
Lentes FoV H / V ajuste IPD	Fresnel 108° / 97° 61-72 mm	Fresnel 110° diag. não	**Pancake** *"100~120°"?* 58-75 mm **automático**	**Pancake** 110° / 96° 58-71 mm	**Fresnel** 97° / 93° 58-63-68 mm	**Asférica** 120° / 105° 56-72mm **automático**
Video Passthrough:	1x cinza	cinza	2x 6.5MP RGB	2x 4MP RGB - 18 PPD		2x RGB - **51 PPD**
Plataforma	**PC** / SteamVR	Google Daydream	Apple visionOS	Meta Horizon PC**		**PC** / SteamVR
Peso	567g	640g	650g + bat.	**515g**	**514g**	1,02kg
Disponibilidade no Brasil / Preço mai/2025	*	*	Sim **R$ 26000**	Sim **R$ 4999**	Sim **R$ 2900**	Sim? *"sob consulta"* US$ 9990

* Obsoleto / descontinuado

** com compressão *lossy*

Canetas para XR

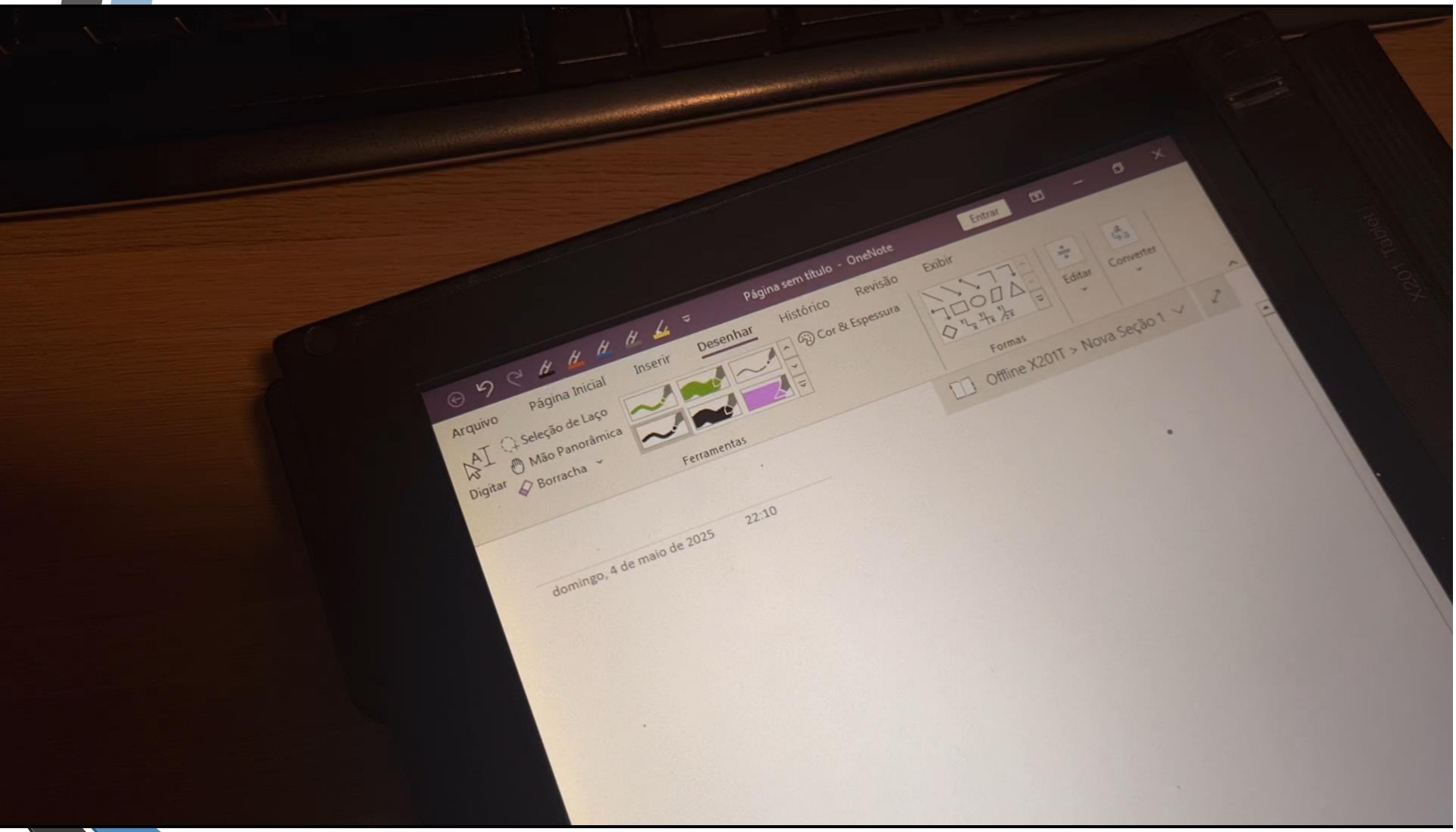
Classe de dispositivo de entrada que pode ser usada em XR.

Modelos podem operar **em 2D** ou **3D**.

História:

1. **Light Pen (1955):** caneta ótica baseada em *timings* de CRT;
2. **Touch resistivo (1974):** pode ser operado por uma "caneta" passiva.
3. **Wacom EMR (1987):** Sensível à *pressão* e *proximidade*, botões extras;
4. **MiniScribe:** 3D, com *encoders*;
5. **GeoMagic Phantom Omni (1994):** 3D, com *force feedback* (**háptico**)

Wacom EMR:



Fonte: o autor - Slide 9

Revware MiniScribe i+:

Fonte: https://revware.net/product/microscribe-i-plus-portable-cmm/

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MicroScribe i+ Series Portable CMM

$11,995.00 – $14,495.00 USD

Affordable. Portable. Precise. Revware's new **MicroScribe *i+*** Portable CMM is an elite desktop coordinate measurement machine that offers fast, flexible, and accurate 3D data collection solutions for a wide variety of applications and industries such as research, inspection, engineering, graphic arts, animation, healthcare, and many more.

Choose from two probe sets based on your data collection needs, **Metrology** or **Landmark**.

Degrees of Freedom 6 DoF

Arm length 25-inch

Probe set Landmark Probe Set

Clear

The MicroScribe 6i+ desktop CMM has 6 degrees of freedom with a 25-inch reach and +/- 0.0020" accuracy.

$13,995.00 USD

In stock

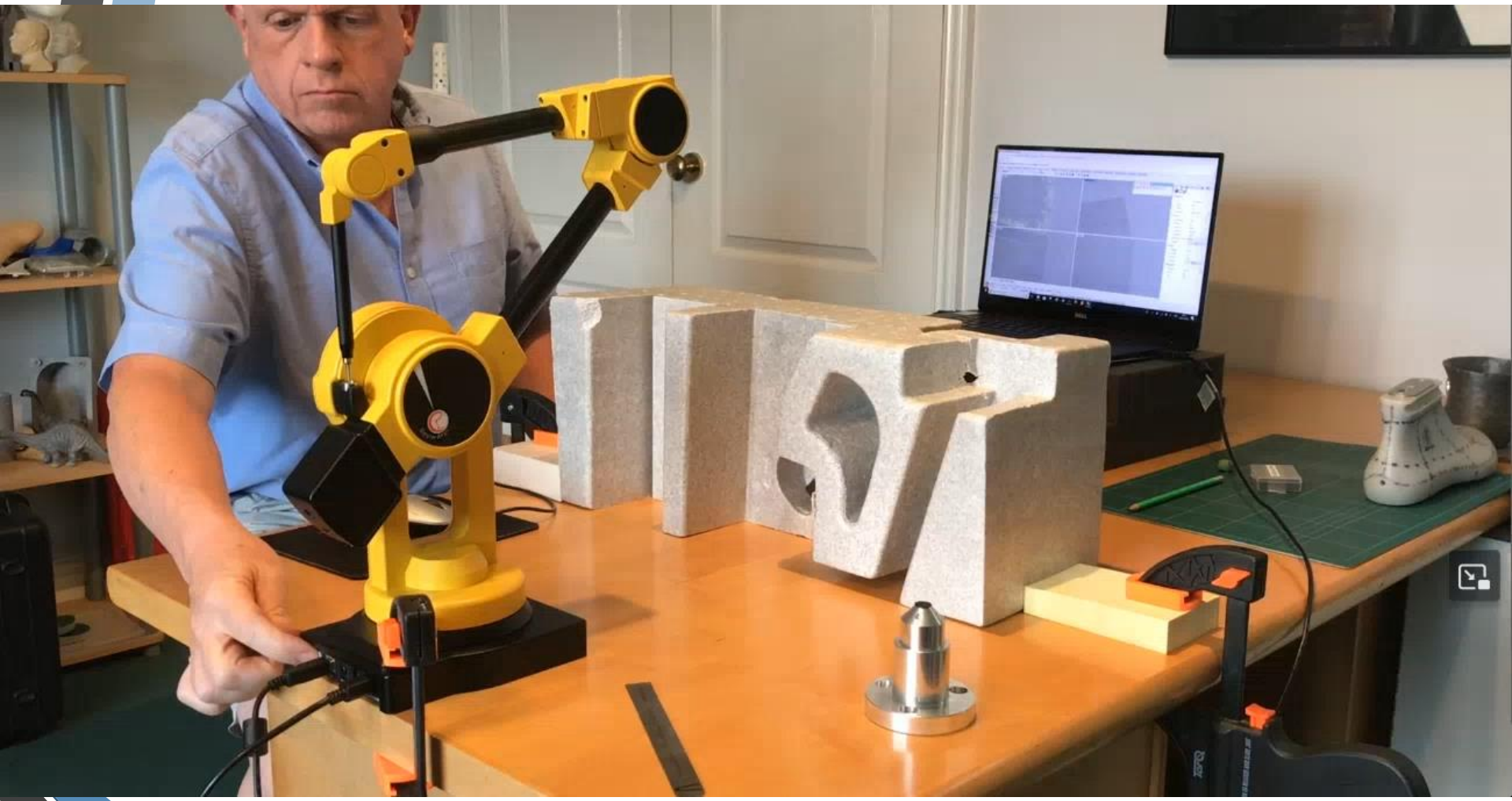
Revware MiniScribe i+:

Fonte: https://revware.net/product/microscribe-i-plus-portable-cmm/

$13,995.00 USD

In stock

Revware MiniScribe i+:



Fonte: https://www.youtube.com/watch?v=fd6gptOZMuQ

Revware MiniScribe i+:

	MicroScribe i+	
Model	i+	iL+
Reach	25 in (.63m)	33 in (.84m)
Work Sphere Diameter	50 in (1.27m)	66 in (1.67m)
Degrees of Freedom	5	5
Accuracy	+/-0.0020 in (0.0508 mm)	+/-0.0025 in* (0.0635 mm)
Weight	8.3 lb (3.8 kg) Most lightweight model	9.1 lb (4.1 kg)
	VIEW BROCHURE →	

Fonte: https://revware.net/product/microscribe-i-plus-portable-cmm/

GeoMagic Phantom Omni (3DSystems Touch)

Fonte: https://www.3dsystems.com/haptics-devices/openhaptics

GeoMagic Phantom Omni (3DSystems Touch)

	Touch	Touch X
Force Feedback Workspace	> 431 W x 348 H x 165 D mm	> 355 W x 228 H x 180 D mm
Footprint	~ 168 W x 203 D mm	~ 168 W x 184 D mm
Weight (device only)	**~1.42 kg**	~3.257 kg
Range of Motion	Hand movement pivoting at wrist	
Nominal Position Resolution	~0.055 mm	**~0.023 mm**
Backdrive Friction	< 0.26 N	**< 0.06 N**
Maximum Exertable Force	3.3 N	**7.9 N**
Continuous Exertable Force	> .88 N	**> 1.75 N**
Stiffness (X / Y / Z, minimum)	1.26 N/ mm, 2.31 N/mm, 1.02 N/mm	**1.86 N/ mm, 2.35 N/mm, 1.48 N/mm**
Inertia (apparent mass at tip)	~ 45 g	**~ 35 g**
Force Feedback	X, Y, Z	
Position Sensing	X, Y, Z (digital encoders)	
Stylus gimbal	Pitch, roll, yaw (± 5% linearity potentiometers)	Pitch, roll, yaw (Magnetic absolute position sensor, 14-bit)
Interface	USB 2.0 / 3.0 port. **1 KHz** refresh rate	USB 2.0 / 3.0 port. Up to **4 KHz** refresh rate

Fonte: https://www.3dsystems.com/haptics-devices/touch-x

Exemplo de aplicação Geomagic Touch

Efficacy of AR Haptic Simulation for Nursing Student Education

Publisher: IEEE

Cite This

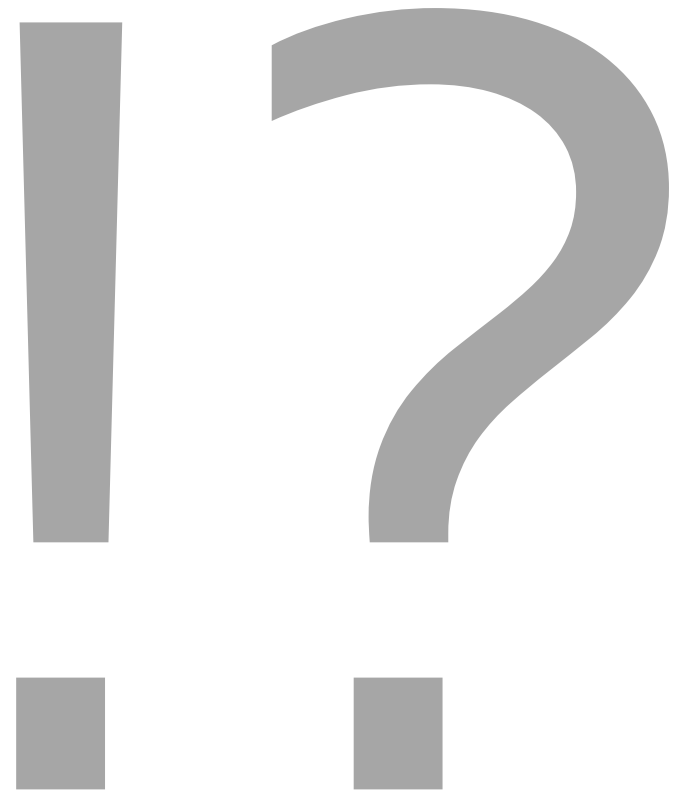
PDF

Meldin Bektic ; Adam Tischler ; Nathaniel Fahey ; Kwangtaek Kim ; Lisa Onesko **All Authors**

Abstract:

In this study we examine the effectiveness of using AR haptic simulation as a tool for nursing students to learn physical attributes related to diseases, as well as testing with the simulation rather than pen & paper. We utilize edema, a medical condition that causes swelling in the body's tissues, as an example the students can learn and be tested on. The simulation takes advantage of the Magic Leap and Geomagic Touch as the AR headset and haptic device of choice. Students use these technologies to see different examples of legs that have varying degrees of edema in a 3D space and use the Geomagic Touch to feel the virtual leg. When pressing upon the leg, the object has deformation capabilities which allow the user to see and feel the impressions made upon the skin. We tested this under four different conditions, a desktop 2D version with haptics disabled and enabled, and an AR 3D version with haptics disabled

Fonte: https://ieeexplore.ieee.org/document/9677828



Referências

- VR-Compare: https://vr-compare.com/

MicroScribe:

- https://gomeasure3d.com/microscribe/
- https://revware.net/product/microscribe-i-plus-portable-cmm/

Phantom Omni / 3DSystems Touch:

- https://www.3dsystems.com/haptics-devices/touch
- https://delfthapticslab.nl/device/phantom-omni/