

Carmine Elvezio

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<https://www.linkedin.com/in/carmine-elvezio>

EDUCATION

Columbia University, New York, NY

Doctor of Philosophy, Computer Science, June 2021

Advisor: *Professor Steven Feiner*

Thesis: *XR Development with the Relay & Responder Pattern*

Columbia University, New York, NY

Master of Philosophy, Computer Science, May 2021

Columbia University, New York, NY

Master of Science, Computer Science, May 2012

Polytechnic Institute of New York University, Brooklyn, NY

Bachelor of Science, Computer Science, Summa Cum Laude, June 2010

NYU-Polytechnic Institute Presidential Scholarship, Lamelson Scholarship

EXPERIENCE

Apple Inc. (Sunnyvale, CA)

November 2021–Present

AR Prototyping Engineer

- Developed AR prototypes and tools to support the release of Apple Vision Pro
- Created systems facilitating the preparation and execution of user studies
- Performed statistical analysis of system data for design and development purposes
- Mentored interns and guided them in completing their internship projects
- Presented studies, tools, and prototypes to executives, designers, and engineers across the company

Columbia University, New York, NY

August 2021–November 2021

Postdoctoral Researcher—Computer Graphics and User Interfaces Lab (Prof. Steven Feiner)

- Developed 3D virtual environments for distributed collaboration for decision making across a broad range of application domains
- Designed an XR interface allowing for secure and private communications when in multi-user VR settings and while using AR devices outdoors
- Developed AR interface supporting spatialized haptic sensations through handheld controllers using stereoscopic actuators
- Presented work at conferences, universities, and companies in Europe

Cornell University and Columbia University, New York, NY

June 2021–July 2021

Guest Lecturer

- Developed and taught XR Bootcamp at *NSF Research Experiences for Undergraduates Program: Making Augmented and Virtual Reality Accessible*

Columbia University, New York, NY

September 2019–June 2021

PhD Student—Computer Graphics and User Interfaces Lab (Prof. Steven Feiner)

- Studied and developed **XR (AR/VR/MR) and haptic interaction and visualization** techniques, associated applications, and supporting frameworks across several domains including medicine, maintenance, aerospace, music, and rehabilitation, working with technologies including HoloLens 1/2, Oculus, SteamVR, and Unity
- Completed **dissertation** on a new software pattern for XR development, released as an open-source project
- Published in *ACM UIST*, *CHI*, and *SUI*, and *IEEE ISMAR*, *VR*, and *IROS*
- Managed and advised internships and student research in the CGUI lab
- Assisted teaching *3D User Interfaces and Augmented Reality* and *Topics in AR/VR*

Columbia University, New York, NY

September 2010–August 2019

Research Staff—Computer Graphics and User Interfaces Lab (Prof. Steven Feiner)

- Studied and developed XR interaction techniques, associated applications, and supporting frameworks

- Created numerous task guidance systems for XR devices, including Microsoft HoloLens, Oculus, and Vive, using Unity, Unreal, MRTK, Vuforia, ARKit, and ARCore
- Developed **hybrid XR systems** for 3D content exploration (including for urban data visualization) using motion tracked head-worn displays, haptic devices, hand-held mobile devices, and multi-touch displays
- Developed and studied XR medical visualization systems aiding doctors in **complex surgical tasks** and for representing symptoms of different **ophthalmological** and neurological conditions
- Created XR calibration tools, video streaming protocols, and XR headset/controller device drivers for Unity
- Created and delivered many XR prototypes for industry and academic partners

Columbia University, New York, NY

December 2011–June 2012

Research Assistant—Columbia Robotics Group (Prof. Peter Allen)

- Created database interface for manipulation of robotic hands and automated grasp selection using brain control interfaces (OpenGL/Qt)

ARchemist, New York, NY

November 2011–July 2012

Software Engineer—Server Development

- Created 3D model database with support for streaming content to mobile platforms
- Developed server and web interface to manage 3D model database
- Worked on streaming system for compact 3D model transmission over network

Polytechnic Institute of New York University, New York, NY

May 2009–July 2010

Consultant/Research Assistant—Games for Learning Institute (Prof. Joel M. Wein)

- Created animation API and graphics tools (DirectX/XNA) for educational games

SKILLS

Graphics Platforms: Unity, Unreal, OpenGL, Vulkan, Direct3D, RealityKit, Metal
XR Platforms/APIs: Oculus, Vive, SteamVR, MRTK, HoloLens, Vuforia, ARCore, ARToolkit, SwiftUI, UIKit, ARKit

Languages: C, C++, C#, GLSL, HLSL, Java, Python, PHP, CUDA, Swift

OSs: Windows (.NET/COM), macOS, Linux, iOS, Android

Graphics: Multi-core rendering, simulation, GPU, engine development, 3D math

UX and UI design: JavaScript, XAML, HTML, Figma, CSS, Bootstrap

Data Analysis: Python, R, Prism, Tableau, Splunk, proficient with various statistical methods

Project Management: Asana, Trello, Jira, Scrum/Agile

AWARDS

Columbia Department of Computer Science—PhD Service Award 2020-2021

IEEE VR 2020—Best Demo Award

XREye: Simulating Visual Impairments in Eye-Tracked XR

Columbia Data Science Day 2019—Best Demo Award

Collaborative exploration of urban data in virtual and augmented reality

NYC Media Lab Summit 2019—1st Place in Future Interfaces and Spatial Computing Prize

Bounce! Collaborative VR for Low-Latency Interaction

IEEE VR 2019—Best Conference Paper Nomination

ICthroughVR: Illuminating Cataracts through Virtual Reality

NYC Media Lab Summit 2018—1st Place in XR Prize

Collaborative Exploration of Urban Data in VR and AR

NYC Media Lab Summit 2017—Grand Prize

Travel in Large-Scale Head-Worn VR: Pre-oriented Teleportation with WIMs and Previews

NYC Media Lab Summit 2017—3rd Place Prize

Remote Collaboration in AR and VR using Virtual Replicas

Polytechnic Institute of NYU—Presidential Scholarship

Polytechnic Institute of NYU—Lamelson Scholarship

PAPER PUBLICATIONS

- Samuel, S., Elvezio, C., Khan, S., Bitzer, L.Z., Moss-Salentijn, L. and Feiner, S., 2024. Visuo-Haptic VR and AR Guidance for Dental Nerve Block Education. *IEEE Transactions on Visualization & Computer Graphics*, (01), pp.1-10. <https://doi.org/10.1109/TVCG.2024.3372125>
- Sadri, S., Loeb, G.J., Grinshpoon, A., Elvezio, C., Sun, S.H., Ng, V.G., Khalique, O., Moses, J.W., Einstein, A.J., Patel, A.J. and George, I., 2024. First experience with augmented reality guidance for cerebral embolic protection during TAVR. *JACC: Advances*, 3(3), p.100839. <https://doi.org/10.1016/j.jacadv.2024.100839>
- Boghossian, A., Cordero, S.I., Elvezio, C., Sanchez-Zarate, S., Yang, B., Guo, S., Ashikin, Q., Salzman, J., Tinto, K., Feiner, S. and Bell, R., 2023. Augmented Reality and Virtual Reality for Ice-Sheet Data Analysis. *IGARSS 2023-2023 IEEE International Geoscience and Remote Sensing Symposium* (pp. 52-55). <https://doi.org/10.1109/IGARSS52108.2023.10283077>
- Krösl, K., Medeiros, M. L., Huber, M., Feiner, S.K., & Elvezio, C., 2023. Exploring the Educational Value and Impact of Vision-Impairment Simulations on Sympathy and Empathy with XREye. *Multimodal Technologies and Interaction* 7, no. 7: 70. <https://doi.org/10.3390/mti7070070>
- Liu, J.-S., Elvezio, C., Tversky, B., & Feiner, S. K., 2021. Using Multi-Level Precueing to Improve Performance in Path-Following Tasks in Virtual Reality. *2021 IEEE International Symposium on Mixed and Augmented Reality (ISMAR), Journal Track*. Bari, Italy. IEEE. <https://doi.org/10.1109/tvcg.2021.3106476>
- Rausch, T., Hummer, W., Stippel, C., Vasiljevic, S., Elvezio, C., Dustdar, S., & Krösl, K., 2021. Towards a Platform for Smart City-Scale Cognitive Assistance Applications. *2021 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VR)*.
- Krösl, K., Elvezio, C., Luidolt, L. R., Hürbe, M., Karst, S., Feiner, S., & Wimmer, M., 2020. CatARact: Simulating cataracts in augmented reality. *2020 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, 682–693. <https://doi.org/10.1109/ISMAR50242.2020.00098>
- Sadri, S., Kohen, S. A., Elvezio, C., Sun, S. H., Basu, N., Grinshpoon, A., Loeb, G. J., Feiner, S. K., 2019. Manipulating 3D Anatomic Models in Augmented Reality: Comparing a Hands-Free Approach and a Manual Approach. *IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*. Beijing, China: IEEE. <https://doi.org/10.1109/ISMAR-Adjunct51615.2020.00035>
- Krösl, K., Elvezio, C., Wimmer, M., Hürbe, M., Feiner, S., & Karst, S., 2019. ICthroughVR: Illuminating Cataracts through Virtual Reality. *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, 655–663. <https://doi.org/10.1109/VR.2019.8798239> (**Best Conference Paper Nomination**)
- Elvezio, C., Sukan, M., & Feiner, S., 2018. Mercury: A messaging framework for modular UI components. *Proc. 2018 ACM Conference on Human Factors in Computing Systems (CHI)*, 1–12, 2018-April. <https://doi.org/10.1145/3173574.3174162>
- Furuya, H., Wang, L., Elvezio, C., & Feiner, S. K., 2018. A Comparative Ground Study of Prototype Augmented Reality Task Guidance for International Space Station Stowage Operations. *Proc. 69th International Astronautical Congress*, 5785–5795. https://www.researchgate.net/publication/337783822_A_Comparative_Ground_Study_of_Prototype_Augmented_Reality_Task_Guidance_for_International_Space_Station_Stowage_Operations
- Sukan, M., Elvezio, C., Feiner, S., & Tversky, B., 2016. Providing assistance for orienting 3D objects using monocular eyewear. *Proc. 2016 Symposium on Spatial User Interaction (SUI)*, 89–98. <https://doi.org/10.1145/2983310.2985764>
- Elvezio, C., Sukan, M., & Feiner, S., 2016. A framework to facilitate reusable, modular widget design for real-time interactive systems. *2016 IEEE 9th Workshop on Software Engineering and Architectures for Realtime Interactive Systems (SEARIS 2016)*, 1–7. <https://doi.org/10.1109/SEARIS.2016.7551586>

- Oda, O., Elvezio, C., Sukan, M., Feiner, S., & Tversky, B., 2015. Virtual replicas for remote assistance in virtual and augmented reality. *Proc. 28th Annual ACM Symposium on User Interface Software and Technology (UIST)*, 405–415. <https://doi.org/10.1145/2807442.2807497>
- Sukan, M., Elvezio, C., Oda, O., Feiner, S., & Tversky, B., 2014. ParaFrustum: Visualization Techniques for Guiding a User to a Constrained Set of Viewing Positions and Orientations. *Proc. 27th Annual ACM Symposium on User Interface Software and Technology (UIST)*, 331–340. <https://doi.org/10.1145/2642918.2647417>
- Weisz, J., Elvezio, C., & Allen, P. K., 2013. A user interface for assistive grasping. *IEEE International Conference on Intelligent Robots and Systems (IROS)*, 3216–3221. <https://doi.org/10.1109/IROS.2013.6696813>

CONFERENCE AND JOURNAL ABSTRACTS

- Boghossian, A., Cordero, S. I., Sanchez-Zarate, S., Elvezio, C., Tinto, K., Feiner, S., & Bell, R. (2021). Uncovering the origin of basal features at the Ross Ice Shelf using radar and augmented reality. NASA ADS, 2021, NS13A07. <https://ui.adsabs.harvard.edu/abs/2021AGUFMNS13A..07B/abstract>
- Kohen, S., Elvezio, C., & Feiner, S. (2021). HoloFight: An Augmented Reality Fighting Game. *ACM SIGGRAPH 2021 Immersive Pavilion*. <https://doi.org/10.1145/3450615.3464531>
- Krösl, K., Elvezio, C., Hürbe, M., Karst, S., Feiner, S., & Wimmer, M. (2020). XREye: Simulating visual impairments in eye-tracked XR. *2020 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW)*, 831–832. <https://doi.org/10.1109/VRW50115.2020.00266>
- Kohen, S., Elvezio, C., & Feiner, S. (2020). MiXR: A Hybrid AR Sheet Music Interface for Live Performance. *2020 IEEE International Symposium on Mixed and Augmented Reality Adjunct (ISMAR-Adjunct)*, 76–77. <https://doi.org/10.1109/ISMAR-Adjunct51615.2020.00035>
- Ling, F. F., Elvezio, C., Bullock, J., Henderson, S., & Feiner, S. (2019). A Hybrid RTK GNSS and SLAM Outdoor Augmented Reality System. *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, 1044–1045. <https://doi.org/10.1109/VR.2019.8798315>
- Elvezio, C., Ling, F., Liu, J.-S., Tversky, B., & Feiner, S. (2018). Collaborative Exploration of Urban Data in Virtual and Augmented Reality. *ACM SIGGRAPH 2018 Virtual, Augmented, and Mixed Reality*, 10:1–10:1. <https://doi.org/10.1145/3226552.3226570>
- Elvezio, C., Amelot, P., Boyle, R., Wes, C. I., & Feiner, S. (2018). Hybrid UIs for Music Exploration in AR and VR. *Adjunct Proceedings of the IEEE International Symposium for Mixed and Augmented Reality 2018*. 411–412. <https://doi.org/10.1109/ISMAR-Adjunct.2018.00121>
- Elvezio, C., Ling, F., Liu, J.-S., & Feiner, S. (2018). Collaborative Virtual Reality for Low-Latency Interaction. *The 31st Annual ACM Symposium on User Interface Software and Technology Adjunct Proceedings*, 179–181. <https://doi.org/10.1145/3266037.3271643>
- Furuya, H., Wang, L., Elvezio, C., & Feiner, S. (2018). Augmented Reality Task Guidance for International Space Station Stowage Operations. *ACM SIGGRAPH 2018 Virtual, Augmented, and Mixed Reality*, 4:1–4:1. <https://doi.org/10.1145/3226552.3226579>
- Sadri, S., Loeb, G., Grinshpoon, A., Elvezio, C., Velagapudi, P., Ng, V., Khalique, O., Moses, J., Sommer, R., Patel, A., George, I., Hahn, R., Leon, M., Kirtane, A., Nazif, T., Kodali, S., Feiner, S., and Vahl, T. (2018). Abstract 12019: Augmented Reality Guidance for Cerebral Embolic Protection (CEP) With the Sentinel Device During Transcatheter Aortic Valve Replacement (TAVR): First-In-Human Study. *Circulation*, 138(Suppl_1), A12019–A12019. https://doi.org/10.1161/circ.138.suppl_1.12019 (https://www.ahajournals.org/doi/10.1161/circ.138.suppl_1.12019)
- Grinshpoon, A., Sadri, S., Loeb, G. J., Elvezio, C., & Feiner, S. (2018). Hands-Free Interaction for Augmented Reality in Vascular Interventions. *Proc IEEE Virtual Reality*. IEEE. 751–752. <https://doi.org/10.1109/VR.2018.8446259>
- Loeb, G., Sadri, S., Grinshpoon, A., Carroll, J., Cooper, C., Elvezio, C., Mutasa, S., Mandigo, G., Lavine, S., Weintraub, J., Einstein, A., Feiner, S., and Meyers, P. (2018). 3:54 PM Abstract No.

- 29 Augmented reality guidance for cerebral angiography. *Journal of Vascular and Interventional Radiology*, 29(4), S17. <https://doi.org/10.1016/j.jvir.2018.01.036>
- Elvezio, C., Sukan, M., Oda, O., Feiner, S., & Tversky, B. (2017). Remote collaboration in AR and VR using virtual replicas. *ACM SIGGRAPH 2017 VR Village, SIGGRAPH 2017*. <https://doi.org/10.1145/3089269.3089281>
- Elvezio, C., Sukan, M., Tversky, B., & Feiner, S. (2017). Travel in Large-Scale Head-Worn VR: Pre-oriented Teleportation with WIMs and Previews. *2017 IEEE Virtual Reality (VR)*. 475–476. <https://doi.org/10.1109/VR.2017.7892386>
- Elvezio, C., Sukan, M., Feiner, S., Tversky, B. (2015, September). [POSTER] Interactive Visualizations for Monoscopic Eyewear to Assist in Manually Orienting Objects in 3D. *2020 IEEE International Symposium on Mixed and Augmented Reality Adjunct (ISMAR-Adjunct)* 180–181. <https://doi.org/10.1109/ISMAR.2015.54>

ACADEMIC AND INDUSTRY POSTER PRESENTATIONS

- Ling, F. F., Elvezio, C., Bullock, J., Henderson, S., & Feiner, S. A Hybrid RTK GNSS and SLAM Outdoor Augmented Reality System. *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, March 23–27, 2019.
- Elvezio, C., Sukan, M., & Feiner, S. A Framework to Facilitate Reusable, Modular Widget Design. *Tristate Workshop on Imaging and Graphics*, New York University, April 25, 2016.
- Elvezio, C., Sukan, M., Feiner, S., & Tversky, B. Interactive Visualizations for Monoscopic Eyewear to Assist in Manually Orienting Objects in 3D. *Tristate Workshop on Imaging and Graphics*, New York University, April 25, 2016.
- Elvezio, C., Sukan, M., Feiner, S., & Tversky, B. Interactive Visualizations for Monoscopic Eyewear to Assist in Manually Orienting Objects in 3D. *Data Science Day*, Data Science Institute, Columbia University, April 6, 2016.
- Oda, O., Elvezio, C., Sukan, M., Feiner, S., & Tversky, B. Remote Task Assistance in Virtual and Augmented Reality. *Data Science Day*, Data Science Institute, Columbia University, April 6, 2016.
- Elvezio, C., Sukan, M., Feiner, S., & Tversky, B. Interactive Visualizations for Monoscopic Eyewear to Assist in Manually Orienting Objects in 3D. *2015 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, S&T Poster Sessions, September 30–October 2, 2015.
- Oda, O., Elvezio, C., Sukan, M., Feiner, S., & Tversky, B. Remote Task Assistance in Virtual and Augmented Reality. *Tristate Workshop on Imaging and Graphics*, Columbia University, April 19, 2015.
- Sukan, M., Elvezio, C., Oda, O., Feiner, S., & Tversky, B. ParaFrustum: Visualization Techniques for Guiding a User to a Constrained Set of Viewing Positions and Orientations. *Tristate Workshop on Imaging and Graphics*, Columbia University, April 19, 2015.
- Elvezio, C., Dedual, N., & Feiner, S. Visualizing and Interacting with Urban Data in Augmented Reality. *Institute for Data Sciences and Engineering Symposium*, Columbia University, April 5, 2013.

INVITED AND REFEREED DEMOS

- Kohen, S., Elvezio, C., & Feiner, S. HoloFight: An Augmented Reality Fighting Game. *ACM SIGGRAPH 2021 Immersive Pavilion*, Online, August 9–13, 2021.
- Kohen, S., Elvezio, C., & Feiner, S. MiXR: A Hybrid AR Sheet Music Interface for Live Performance. *2020 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, Research Demos, Online, November 3–November 9, 2020.
- Elvezio, C., Liu, J.-S., Sekaran, J., Kinoshita, Y., Oomori, K., Shimizu, K., Meguro, S., Hiraishi, T., and Feiner, S., Fastball: An augmented reality ballgame between New York and Tokyo (Columbia University & Hakuhodo). *NYC Media Lab Summit*, Online, New York, NY, October 7–9, 2020.

- Krösl, K., Elvezio, C., Hürbe, M., Karst, S., Feiner, S., & Wimmer, M. XREye: Simulating Visual Impairments in Eye-Tracker XR. *2020 IEEE Virtual Reality (VR)*, Research Demos, Online, March 22–March 26, 2020. **(Best Demo Award)**
- Sadri, S., Kohen, S., Elvezio, C., Sun, S., Basu, N., Grinshpoon, A., Loeb, G., and Feiner, S., Manipulating 3D anatomic models in augmented reality: Comparing a hands-free approach and a manual approach. *IEEE ISMAR 2019*, Beijing, China, October 14–18, 2019.
- Elvezio, C., Ling, F. F., Liu, J.-S., & Feiner, S. Bounce! Collaborative VR for Low-Latency Interaction. *NYC Media Lab Summit*, The New School, New York, NY, September 26, 2019. **(1st Place in Future Interfaces and Spatial Computing Prize)**
- Elvezio, C., Ling, F., Liu, J.-S., Tversky, B., & Feiner, S. Collaborative exploration of urban data in virtual and augmented reality. *Data Science Day*, Data Science Institute, Columbia University, New York, NY, April 5, 2019. **(Best Demo Award)**
- Elvezio, C., Ling, F., Liu, J.-S., & Feiner, S. 5G Healthcare: Remote Rehabilitation. *Snapdragon Tech Summit 2018*, Maui, HI, December 4–6, 2018.
- Elvezio, C., Amelot, P., Boyle, R., Wes, C. I., & Feiner, S. Hybrid UIs for Music Exploration in AR and VR. *2018 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, Research Demos, October 16–20, 2018.
- Elvezio, C., Ling, F., Liu, J.-S., & Feiner, S. Collaborative Virtual Reality for Low-Latency Interaction. *2018 ACM Symposium on User Interface Software and Technology (UIST 2018)*, Berlin, Germany, October 14–17, 2018.
- Grinshpoon, A., Sadri, S., Loeb, G. J., Elvezio, C., & Feiner, S. Hands-free augmented reality for vascular interventions. *NYC Media Lab: Exploring Future Reality '18*, NYU, New York, NY, November 29, 2018.
- Elvezio, C., Ling, F., Liu, J.-S., & Feiner, S. Collaborative Exploration of Urban Data in VR and AR. *NYC Media Lab Summit*, The New School, New York, NY, September 20–21, 2018. **(1st Place in XR Prize)**
- Elvezio, C., Ling, F., Liu, Siu, S., J.-S., & Feiner, S. 5G Healthcare: Remote Rehabilitation. *Mobile World Congress Americas (MWCA) 2018*, Los Angeles, September 12–14, 2018.
- Elvezio, C., Ling, F., Liu, J.-S., Tversky, B., & Feiner, S. Collaborative exploration of urban data in virtual and augmented reality. *ACM SIGGRAPH 2018 Virtual, Augmented, and Mixed Reality (SIGGRAPH '18)*, Vancouver, BC, August 12–16, 2018.
- Furuya, H., Wang, L., Elvezio, C., & Feiner, S. Augmented reality task guidance for international space station stowage operations. *ACM SIGGRAPH 2018 Virtual, Augmented, and Mixed Reality (SIGGRAPH '18)*, Vancouver, BC, August 12–16, 2018.
- Grinshpoon, A., Sadri, S., Loeb, G. J., Elvezio, C., & Feiner, S. Hands-free augmented reality for vascular interventions. *ACM SIGGRAPH 2018 Emerging Technologies (SIGGRAPH '18)*, Vancouver, BC, August 12–16, 2018.
- Elvezio, C., Ling, F., Liu, J.-S., & Feiner, S. ReCoVR: Realtime collaborative virtual reality. *Verizon Open Innovation Lab Media Day*, Alley Chelsea, New York, NY, May 7, 2018.
- Elvezio, C., Ling, F., Liu, J.-S., Mao, C., Zenelli, A., Tversky, B., & Feiner, S. Shared VR and AR. *Columbia Alumni Association STEM Day*, Columbia University, New York, NY, June 10, 2018.
- Elvezio, C., Ling, F., Liu, J.-S., Tversky, B., & Feiner, S. Collaborative exploration of urban data in virtual and augmented reality. *Data Science Day*, Data Science Institute, Columbia University, New York, NY, March 28, 2018.
- Grinshpoon, A., Sadri, S., Loeb, G. J., Elvezio, C., & Feiner, S. Hands-Free Interaction for Augmented Reality in Vascular Interventions. *2018 IEEE Virtual Reality (VR)*, Research Demos, Reutlingen, Germany, March 18–March 22, 2018.
- Elvezio, C., Sukan, M., Tversky, B., & Feiner, S. Travel in Large-Scale Head-Worn VR: Pre-oriented Teleportation with WIMs and Previews. *NYC Media Lab Summit*, The New School, New York, NY, September 28, 2017. **(Grand Prize)**

- Elvezio, C., Sukan, M., Oda, O., Feiner, S., & Tversky, B. Remote Collaboration in AR and VR using Virtual Replicas. *NYC Media Lab Summit*, The New School, New York, NY, September 28, 2017. **(3rd Place Prize)**
- Grinshpoon, A., Sadri, S., Loeb, G. J., Elvezio, C., & Feiner, S. Hands-free Interaction for Augmented Reality in Vascular Interventions. *NYC Media Lab Summit*, The New School, New York, NY, September 28, 2017.
- Elvezio, C., Sukan, M., Oda, O., Feiner, S., & Tversky, B. Remote Collaboration in AR and VR using Virtual Replicas. *ACM SIGGRAPH 2017 VR Village (SIGGRAPH '17)*, Los Angeles, CA, July 30–August 3, 2017.
- Elvezio, C., Sukan, M., Tversky, B., & Feiner, S. Travel in Large-Scale Head-Worn VR: Pre-oriented Teleportation with WIMs and Previews. *Data Science Day*, Data Science Institute, Columbia University, New York, NY, April 5, 2017.
- Elvezio, C., Sukan, M., Tversky, B., & Feiner, S. Travel in Large-Scale Head-Worn VR: Pre-oriented Teleportation with WIMs and Previews. *2017 IEEE Virtual Reality (VR)*, Research Demos, Los Angeles, CA, March 20–March 22, 2017.
- Sukan, M., Elvezio, C., Feiner, S., & Tversky, B. Interactive Visualizations for Monoscopic Eyewear to Assist in Manually Orienting Objects in 3D. *NYC Media Lab: Exploring Future Reality*, Viacom, New York, NY, November 10, 2016.
- Sukan, M., Elvezio, C., Feiner, S., & Tversky, B. Interactive Visualizations for Monoscopic Eyewear to Assist in Manually Orienting Objects in 3D. *NYC Media Lab Summit*, Columbia University, New York, NY, September 22, 2016.
- Sukan, M., Elvezio, C., Oda, O., Feiner, S., & Tversky, B. Augmented Reality for Task Assistance and ParaFrustum: Visualization Techniques for Guiding a User to a Constrained Set of Viewing Positions and Orientations. *Data Science Institute: Data on a Mission*, Columbia University, New York, NY, March 31, 2015.
- Sukan, M., Elvezio, C., Oda, O., Feiner, S., & Tversky, B. Augmented Reality for Task Assistance and ParaFrustum: Visualization Techniques for Guiding a User to a Constrained Set of Viewing Positions and Orientations. *NYC Media Lab: Exploring Future Reality*, Columbia University, New York, NY, November 5, 2015.

TEACHING

Cornell/Columbia XR REU - XR Boot Camp

Cornell University & Columbia University
Guest Lecturer
June 2021

COMS 6998—Topics in AR and VR

Columbia University, Professor Steven Feiner
TA, Co-taught subset of lectures
Fall 2020

COMS 4172—3D User Interfaces and Augmented Reality

Columbia University, Professor Steven Feiner
TA, Co-taught subset of lectures
Spring 2012-Spring 2021

Introduction to Data Structures and Algorithms

Polytechnic Institute of NYU, Professor Lisa Hellerstein
TA
Spring 2008

TALKS & PANELS

- Elvezio, C., XR Development with the Relay & Responder Pattern. In-person & Online, Universitat de Barcelona, Barcelona, Spain, July 21, 2021.
- Technische Universität Wien & VRVis, Vienna, Austria, July 14, 2021.

- Snap Research Vienna, Vienna, Austria, July 12, 2021.
- Hasso Plattner Institut, Potsdam, Germany, July 9, 2021.
- Université Paris-Saclay, Paris, France, July 5, 2021.
- Elvezio, C., XR Development with the Relay & Responder Pattern. (PhD Dissertation Defense) In-person & online, Columbia University, New York, NY, May 21, 2021.
- Elvezio, C., XR Development with the Relay & Responder Pattern. (PhD Thesis Proposal) Online, Columbia University, New York, NY, April 5, 2021.
- Elvezio, C., et al., Graduate STEM Student Panel, Scientists and Engineers for a Better Society (SEBS) Online, Columbia University, New York, NY, March 12, 2021.
- Elvezio, C., A Survey of Development Tools for XR Programmers. (PhD Candidacy Exam) Online, Columbia University, New York, NY, December 22, 2020.
- Elvezio, C., The PhD Project: Demystifying the Dissertation Presentation: Carmine Elvezio. Online, Columbia University, New York, NY, December 10, 2020.
- Elvezio, C., Feiner, S., Pitch Your Lab: Columbia CGUI Lab, *2018 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)* Conference, Munich, Germany, October 17, 2018.
- Elvezio, C., Ling, F., Liu, J-S., Tversky, B., Feiner, S., Collaborative Exploration of Urban Data in Virtual and Augmented Reality. *ACM SIGGRAPH 2018 Virtual, Augmented, and Mixed Reality (SIGGRAPH '18)*, Vancouver, BC, August 12, 2018.
- Elvezio, C., Sukan, M., Feiner, S., Mercury: A Messaging Framework with Relay Nodes and Responders for Modular UI Components. *2018 ACM Conference on Human Factors in Computing Systems (CHI)*, Montreal, Québec, Canada, April 26, 2018.

ACADEMIC AND COMMUNITY SERVICE

- ACM VRST reviewer:** 2021, 2019
- ACM UIST reviewer:** 2018, 2019, 2020
- ACM CHI reviewer:** 2017, 2019, 2020
- ACM SIGGRAPH reviewer:** 2023
- Columbia Dept. of CS New Undergrad Events and Programming Support:** 2021
- Columbia Dept. of CS PhD Virtual Mentor:** 2021
- Columbia Dept. of CS PhD Prospective Student Visit Day:** 2021
- Columbia Dept. of CS Grad Social Events Support—Student Services:** 2020–2021
- Columbia SEAS WISC Holistic Academic Mentoring:** 2020–2021
- Columbia University Task Force on Inclusion and Belonging:** 2020–2021
- Columbia University KOCH COVID Ambassador Program:** 2020–2021
- Columbia Dept. of CS PhD Instagram Takeover:** 2020
- Columbia University, Bergen County Academies Senior Experience Mentor:** 2018–2021
- Columbia Engineering STEM Day:** 2018
- IEEE ISMAR reviewer:** 2021
- IEEE VR reviewer:** 2019
- Polytechnic Institute of NYU Dept. of CS—General Tutor:** 2008–2010

PATENTS & APPLICATIONS

- Feiner, S., Loeb, G., Grinshpoon, A., Sadri, S. and Elvezio, C., Columbia University of New York, 2023. Systems and methods for augmented reality guidance. U.S. Awarded Patent 11,666,385.

Elvezio, C., Sukan, M., Oda, O., Feiner, S. and Tversky, B., Columbia University of New York, 2016. Systems and methods for providing assistance for manipulating objects using virtual proxies and virtual replicas. U.S. Patent Application 15/146,764.

TECHNICAL REPORTS

Sekaran, J., Liu, J-S., Elvezio, C., Feiner, S., *Fastball v2*. Technical Report, Columbia University and Hakuhodo, NYC Media Lab Seed Project. 2020.

Yen, S., J., Liu, J-S., Elvezio, C., Feiner, S., *Fastball*. Technical Report, Columbia University and Hakuhodo, NYC Media Lab Seed Project. 2020.

Feiner, S., Elvezio, C., Ling, F., *CAVIAR (Cyber Affordance Visualization In Augmented Reality)*. Technical Report, CMU SEI Subcontract. 2018.

Feiner, S., Elvezio, C., Sukan, M., *Augmented Reality for Maintenance and Training in NUWC Industrial Operations*. Technical Report, NISE Subcontract. 2015.

OPEN SOURCE PROJECTS

Mercury Messaging

A framework facilitating XR development through cross-component communication in Unity
<https://github.com/ColumbiaCGUI/MercuryMessaging>
Fall 2017-present

GoblinXNA

A platform for research on 3D user interfaces, including mobile AR and VR
<http://monet.cs.columbia.edu/projects/goblin/>
Fall 2011-Spring 2014

SELECTED ACADEMIC RESEARCH PROJECTS

SpaceLine: AR Precueing

Liu, J.-S., Elvezio, C., Tversky, B., & Feiner, S.
AR system showing how graphical precueing can be used to indicate trajectories and improve performance in a series of path-following tasks. *Published in IEEE ISMAR 2021*.

DentAR: Dentistry Training in AR

Elvezio, C., Samuel, S., Comas, E., Zubiaurre Bitzer, L. A., Moss-Salentijn, L., Feiner, S.
A system for guiding dentistry students in learning to complete complex dental procedures, such as Novocain injection, in AR and VR with support for haptic devices. *Submission in progress. 2023*.

AR Notifications

Elvezio, C., Wang, Z., Liu, J.-S., Feiner, S.
An AR/VR system that presents notifications of real-world objects and points of interest when the user gets near. *Submission in progress. 2023*.

CatARact: Simulating Cataracts in Augmented Reality

Krösl, K., Elvezio, C., Luidolt, L. R., Hürbe, M., Karst, S., Feiner, S., & Wimmer, M.
The first medically-informed, pilot-studied simulation of cataracts and other impairments in eye-tracked augmented reality (AR). *Published in IEEE ISMAR 2020*.

MiXR: A Hybrid AR Sheet Music Interface for Live Performance

Kohen, S., Elvezio, C., & Feiner, S.
A system that combines AR, smartphones, and tablets to allow performers to manage and annotate virtual sheet music. *Published in IEEE ISMAR 2020*.

ICthroughVR: Illuminating Cataracts through Virtual Reality

Krösl, K., Elvezio, C., Wimmer, M., Hürbe, M., Feiner, S., & Karst, S.
A parametrizable VR system allowing for the simulation of cataracts to help Ophthalmologists and patients better understand symptoms of the various visual diseases under labelled as cataracts. *Published in IEEE VR 2019*.

CAVIAR: A Hybrid RTK GNSS and SLAM Outdoor Augmented Reality System

Ling, F. F., Elvezio, C., Bullock, J., Henderson, S., & Feiner, S.

A wide-area outdoor wearable AR system that uses RTK GNSS tracking to register maps in AR with a SLAM tracking system. *Published in IEEE VR 2019.*

Manipulating 3D Anatomic Models in Augmented Reality: Comparing a Hands-Free Approach and a Manual Approach

Sadri, S., Kohen, S. A., Elvezio, C., Sun, S. H., Grinshpoon, A., Loeb, G. J., ... Feiner, S. K. A hands-free AR guidance system for vascular interventions, using Microsoft HoloLens, controlled by head motion and speech. *Published in IEEE ISMAR 2019, IEEE VR 2018, ACM SIGGRAPH 2018.*

Mercury: A Messaging Framework for Modular UI Components

Elvezio, C., Sukan, M., & Feiner, S. A framework and encompassing toolkit to facilitate nonspatial communication in the Unity game engine. *Published in ACM CHI 2018.*

Collaborative Exploration of Urban Data in Virtual and Augmented Reality

Elvezio, C., Broudo, L., Chan, M., Ling, F., Liu, J.-S., Tversky, B., & Feiner, S. A collaborative AR/VR multi-user system for visualizing and interacting with social and municipal urban data. *Published in ACM SIGGRAPH 2018, Submission in progress.*

Bounce! Collaborative Virtual Reality For Low-Latency Interaction

Elvezio, C., Ling, F., Liu, J.-S., & Feiner, S. A remote rehabilitative VR game in which two collaborating users simultaneously manipulate virtual objects by controlling a set of physically modeled ropes. *Published in ACM UIST 2018.*

Hybrid UIs for Music Exploration in AR and VR

Elvezio, C., Amelot, P., Boyle, R., Wes, C. I., & Feiner, S. An AR system combining HoloLens, LeapMotion, and touch screens to create a new way to search, organize and enjoy music (powered by the Spotify catalog). *Published in ACM UIST 2018.*

Augmented Reality Task Guidance for International Space Station Stowage Operations

Furuya, H., Wang, L., Elvezio, C., & Feiner, S. K. A system for helping NASA astronauts to complete Stowage packing and loading tasks on the International Space Station, in AR. *Published in the International Astronautical Congress (IAC) 2018, ACM SIGGRAPH 2018.*

Travel in Large-Scale Head-Worn VR: Pre-oriented Teleportation with WIMs and Previews

Elvezio, C., Sukan, M., Tversky, B., & Feiner, S. A VR system allowing users to pre-orient before teleporting in a Virtual Scene, using a World-In-Miniature and preview. *Published in ACM SUI 2016, IEEE ISMAR 2015.*

A Framework to Facilitate Reusable, Modular Widget Design for Real-Time Interactive Systems

Elvezio, C., Sukan, M., & Feiner, S. A light-weight toolkit for Unity facilitating the creating of modular 3D widgets for XR applications and user studies. *Published in IEEE SEARIS 2016.*

Providing Assistance for Orienting 3D Objects Using Monocular Eyewear

Sukan, M., Elvezio, C., Feiner, S., & Tversky, B. A system for exploring different visualization approaches across different paradigms for guiding unconstrained manual 3DoF rotation. *Published in ACM SUI 2016, IEEE ISMAR 2015.*

Remote Collaboration in AR and VR using Virtual Replicas

Elvezio, C., Sukan, M., Oda, O., Feiner, S., & Tversky, B. A hybrid XR system where a remote subject expert views a scene in either AR or VR, to create referential instructions for a technician using AR. *Published in ACM SIGGRAPH 2017, UIST 2015.*

ParaFrustum: Visualization Techniques for Guiding a User to a Constrained Set of Viewing Positions and Orientations

Sukan, M., Elvezio, C., Oda, O., Feiner, S., & Tversky, B. A system for exploring different modalities for representing a range of strategic view poses for optimal viewing. *Published in ACM UIST 2014.*

A User Interface for Assistive Grasping

Weisz, J., Elvezio, & Allen, P.

A 2D UI combining the speed and convenience of preplanned grasps with versatility of an online planner. *Published in IEEE IROS 2013.*

MENTORSHIP (Columbia and NYU Independent Research Project Students)

Sad Adib, Pierre Amelot, Yujin Ariza, Oliver Baltay, Priyanjana Bangani, Maria Barbulescu, Naomi Basu, Siddharth Bhatnagar, Johnathan Bi, Robert Boyle, Lea Broudo, Jacob Bullock, Diana Caraveo, Benjamin Carlin, Matthew Chan, Jenny Chan, Jiahe Chen, Fujunku Chen, Jessica Chen, Julie Chien, Hayun Chong, Edith Comas, Sebastian Cueva-Caro, Dimitar Dinev, Gustave Ducrest, Ethan Edwards, Rachel Etheredge, Steven Fantin, Chihao Feng, Ariel Fleming, Aaron Friedman, Hiroshi Furuya, Manushree Gangwar, Lu Gao, Matthieu Gavaudan, Suwen Ge, Alon Grinshpoon, Dru Grossberg, Yu Gu, Jiakang Guo, Ge Guo, Huy Ha, William Hallett, Anis Harbi, Yilan He, Daniel Hu, Ji Ho Hyun, Maya Iwabuchi, Aruj Jain, Ruijue Ji, Shalva Kohen, Katharina Krösl, Krithika Kuppusamy, Patrick Kwon, Claudia Lauschke, Kathleen Lee, Justin Lee, Hollis Lehv, He Li, Jenny Li, Manxueying Li, Tia Lim, Yida Lin, Yihan Lin, Frank Ling, Jiaqi Liu, Gabrielle Loeb, Kaiji Lu, Yulin Lu, Yeuting Lu, Alan Luo, Anthony Luo, Sahil Mahendrakar, Vaibhav Malpani, Cynthia Mao, Alan McNaney, Yuxuan Mei, Kevin Mejia, Ido Michael, Seth Mishan, Ribo Mo, Saaman Moghadam, Mohanad Mohamed, Wode Ni, Eszter Offertaler, Melissa Ozcan, Minhaz Palasara, Donglai Pan, Su Ji Park, Michal Porubcin, Sarah Radway, Yixiong Ren, Cory Robertson, Madeleine Roodberg, Alexander Rupp-Coppi, Shirin Sadri, Sara Samuel, Sofia Sanchez-Zarate, Harshit Saxena, Emma Schechter, Janane Sekaran, Changmin Seo, Sumiran Shah, Bin Shen, Kishan Sheth, Samuel Silverman, Samantha Siu, Yarden Stern, Vivek Subramaniam, Shawn Sun, Weijie Tang, Rahul Tewari, Morgan Thompson, Luis Tolosa, Alyza Tüchler, Darshana Umakanth, Manasvi Vohra, Linli Wan, Zichuan Wang, Tianfan Wang, Linnan Wang, Tianfan Wang, Shawn Wei, Catherine Wes, Nora Wixom, Brian Wu, Bruce Wu, Yuxuan Xie, Bin Xu, Amy Xu, Benjamin Yang, Lu Yang, Danwen Yang, Spencer Yen, Nazli Yurdakul, Ana Zeneli, Joy Zeng, Xuanyuan Zhang, Davide Zhang, Di Zhu, Elijah Zulu, Noah Zweben