

Motion Capture & Mixed Reality for Live Performance

TPA4930 & TPA6930, Sect MOC4/6 (3 credits)

Fridays: 10:40 am-1:40 pm

Professor: Dr. Heidi Boisvert

Location: Constans Theatre, G011

Email: hboisvert@ufl.edu

Office Hours: Wednesdays & Fridays 2-4 pm (or by Appointment)

Office Location: Nadine McGuire Theatre & Dance Pavilion, Room #233

Office Phone: 352-273-0513 (email is best)



Course Content → Canvas Site: <https://ufl.instructure.com/courses/464051>

Course Collaboration → Slack Workspace: <https://mocapandmixed-twk9019.slack.com>

Course Description:

This course covers the pipeline for face and body tracking in both recorded and live motion capture coupled with machine learning techniques for retargeting avatars and triggering environmental cues in game engines to create virtual, augmented and mixed reality experiences for live performance. Students employ motion capture suits, 3D modeling software and machine learning libraries to control game engines, projection mapping software and show control systems. (Prerequisites: None)

Course Goals:

To give students an introduction to:

- the history and contemporary field of experimental performance employing emerging technology.
- the theory, practice and pipeline for using motion capture technology for games, XR, and live performance.
- the foundational skills and knowledge of AR and VR concepts and 3D graphics programming to develop XR experiences within Unity.
- basic C# programming to customize Unity components.
- the technical terms related to extended reality and motion capture technology.
- the latest technologies and techniques for creating experimental, multi-media performances using motion capture, virtual and augmented reality.
- collaborative strategies for working on teams with different disciplinary skills and backgrounds.

Learning Outcomes:

By the end of the course students will be able to:

- learn correct terminology for technical and design aspects of the field.
- apply emerging technology (motion capture, machine learning, virtual and augmented reality) into their artistic practice.

- explore different interdisciplinary methods of collaboration in order to function as part of a team.
- understand and employ different modalities of design and production and integrate those modalities into an experimental mixed reality performance.
- clearly communicate ideas using contemporary methods to critique the work of their peers both technically and aesthetically.
- discuss the evolving technologies and innovative approaches used by professionals in the field of immersive media.
- make informed decisions about which theories and technologies to employ for creating mixed reality experiences.
- show competency in designing and building mixed reality experiences using motion capture.
- learn how to collaboratively conceptualize and prototype XR performance-based experiences.
- demonstrate professionally documenting projects for inclusion in a portfolio and open source repositories.
- growing development (and programming) skills and critical thinking to better grasp the emerging field of XR
- think critically about the role of the body, data & the future of performance.

Course Materials:

- Canvas
- Slack
- GitHub
- Flash drive & other portable drives or DropBox account to back up files
- Required Readings - Provided as PDFs
- Software Tutorials - Links will be provided
- Journal &/or Sketch Book (Digital or Physical)
- Laptop (Mac or PC)

Relevant Hardware & Software:

- Unity (<https://www.unity.com/>)
- Unreal (<https://www.unrealengine.com/>)
- Maya (<https://www.autodesk.com/products/maya/overview>)
- Rokoko (<https://www.rokoko.com/>)
- Oculus (<https://www.oculus.com/>)
- Vive (<https://www.vive.com/us/>)
- Magic Leap (<https://www.magicleap.com/>)
- Hololens (<https://www.microsoft.com/en-us/hololens>)
- Mad Mapper (<http://madmapper.com/>)
- Metashape (<https://www.agisoft.com/downloads/installer/>)
- DepthKit (<https://www.depthkit.tv/>)
- Houdini (<https://www.sidefx.com/>)
- GitHub (<https://github.com/>)

Recommended Reading List:

Benford, Steve & Gabriella Giannachi. *Performing Mixed Reality*. Cambridge, MA: MIT Press, 2011.

Stern, Nathaniel. *Interactive Art and Embodiment: The Implicit Body as Performance*. Canterbury, UK, Glyphi (Arts Futures Books), 2013.

Mocap for Artists: Workflow and Techniques for Motion Capture by Midori Kitagawa and Brian Windsor, 2008, Focal Press/Elsevier.

Jerald, Jason. *The VR Book: Human-Centered Design for Virtual Reality*. First edition; Association for Computing Machinery; M&C, Morgan & Claypool, 2016.

Schmalstieg, D. & Höllerer, T. *Augmented Reality—Principles and Practices*; Addison-Wesley, 2016.

Michael Madary and Thomas K. Metzinger. 2016. *Real Virtuality: A Code of Ethical Conduct*.

Tony Parisi. 2015. *Learning Virtual Reality*.

Alva Noe. 2004. *Action in Perception*.

Michael Heim. 1994. *The Metaphysics of Virtual Reality*/

Joseph LaViola Jr. et al. *3D user interfaces: theory and practice*. Second edition. Addison-Wesley Professional, 2017.

Steven M. LaValle. *Virtual Reality*. Cambridge University Press, 2017. (PDF and HTML available online).

Delbridge, Matt. *Motion Capture in Performance: An Introduction*, 2015.

Industry Essentials:

<https://voicesofvr.com/>

<https://www.xrmust.com/>

<https://immerse.news/>

<http://www.roadtovr.com/>

<http://vrfocus.com/>

<http://www.vrgeeks.org/vr-geeks/global>

<https://www.frontiersin.org/journals/virtual-reality>

<https://everythingimmersive.com/>

<https://noproscaenium.com/>

Twitter hashtags #vr, #ar #xr #oculusrift, #htcvive #hololens #magicleap #mocap. People constantly share cool stuff there and via other hashtags.

Grading Policy*:

– 20% reading/experience responses

– 20% in class exercises

– 40% final project

– 10% documentation

– 10% participation & attendance

* University grading policy can be found here: <https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/>.

Grading Rubric:

VALUES	Excellent (90-100)	Good (80-89)	Fair (70-79)	Poor (60-69)	Unsatisfactory (0-59)
Concept	Core concept is intriguing, original, and well- explored	Core concept is intriguing but lacking in examination	Core concept is present and supported by the work	Core ideas are scattered without consideration	No clear concept, or work doesn't reflect it
Progress	Clear and consistent progress from ideation to execution	Progress was made, but was not consistent	Evidence of procrastination, "last minute" pushes or crunch	Lack of progress in 1-2 areas resulting in project deficiencies	Little to no progress shown on the project
Presentation	Concept is clearly presented and strongly supported through audio, visuals, interaction, and narrative (if applicable)	Concept is supported through presentation, but 2 or more areas of the design are lacking or distracting	Concept is weakly supported through presentation, project requirements met at a "bare minimum" level	1-2 presentation requirements are not met.	3+ presentation requirements are not met.
Skills	Clear demonstration of skills in all development areas (visual, text, audio, interaction, programming)	Clear demonstration of skill in 2+ development areas	Demonstrates skills, but omits topics covered in class.	Evidence of skills, but underutilization of techniques learned in class	Does not use any techniques learned in class.
Collaboration	Consistently provides honest, supportive feedback to peers, responsible in meeting team goals, communicates effectively.	Generally supportive, responsible, and good communication, with a few issues	Multiple issues/problems with collaboration, meeting goals, or communicating	Little to no evidence of communication, goal setting, and collaboration in a team setting.	Disrespectful to fellow students work, with negative impacts to class/team dynamics.

Expectations:

- **Arrive on time** and attend all classes— see below for attendance policy.
- Spend at least **2-4 additional hours a week** (outside of class) on class projects, readings, experimenting with tech & writing in journal.
- **Check Canvas** for assignments and materials (typically announced and posted at the end of class on Friday).
- **Check Slack** regularly for group and private messages.
- Post weekly reading responses to Canvas **by midnight on Thursdays** unless otherwise specified in the assignment.
- **Actively participate** in class discussions & group critiques.
- **Back up your work** regularly.
- **Follow good device etiquette:** No cell phone use during class. Laptops only used for lecture note-taking and related class activities.
- **Thoughtfully contribute** to a positive classroom environment, while actively supporting and challenging your classmates' ideas.
- **Push yourself creatively and technically.** Be ambitious. Work hard. Stay open and curious!

Communication:

- To contact your instructor with a brief, private question or message, **send a DM (Direct Message) through Slack.**
- If you have a question that may be relevant to the group (about homework, etc.), **post in the #general channel** on Slack for all to see and comment on.
- Use Slack for easy communications with your classmates as well—you can DM individuals or selected groups.
- To discuss a longer matter with your instructor, DM to set up an appointment for office hours.

Attendance Policy:

- Students are expected to attend every class, arrive on time, and actively engage/participate.
- **If you will be absent, or if you are running late, DM your instructor ASAP.**
- In the case of an absence, contact a classmate for notes and what you missed, check Canvas for assignments, and contact the instructor if you have additional questions.
 - Lateness and absences will impact your grade. Worse, not showing up will impact everyone else in the class. As most of our projects are collaborative, we are dependent on everyone's presence and full participation.
 - All in-class activities are graded for participation. Unexcused absences will result in a 0 for participation for the day.

- Unexcused lateness counts as 1/3 absence when up to 25 minutes late, 1/2 absence when 26-50 minutes late, and a full absence beyond that point.
 - Absences may be excused in the following cases: documentation of illness provided by a doctor, religious observance with advance notice, official school-related activity (with documentation and advanced notice), and on a case-by-case basis for other critical events.
 - Project critiques are mandatory and cannot be made up. Missing a critique will result in a deduction of one letter grade for the corresponding project.
- For University Attendance Policy, please refer to this link: <https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>.

Academic Integrity Policy:

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Conduct Code specifies a number of behaviors that are in violation of this code and the possible sanctions. [Click here to read the Conduct Code.](#) If you have any questions or concerns, please consult with the instructor or TAs in this class.

Instructor Note: Code borrowed from another source at more than four lines in length must be attributed as a //comment within the code itself. If you are unsure of whether or not your work may constitute plagiarism, please check with your instructor before submitting.

In-Class Recording:

- Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between

students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

Course Accommodations for Students with Disabilities:

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center here: <https://disability.ufl.edu/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Student Evaluation Requirements:

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

Course Structure (Lecture, Lab & Demos):

Lecture/Demo - Context setting and introducing tools & techniques

Lab/In Class Exercise - Scaffold development pipeline and experimentation

Read/Respond - Critically engage with readings/videos by writing up a short reaction to key points in preparation for discussion

Experience/Deconstruct - Research new motion capture and mixed reality works & identify narrative devices, experience design strategies and emerging technologies employed to build a collective toolbox.

Studio - Hands-on, collaborative project development

Course Schedule:

// Week 1 - Friday, August 26th - INTRODUCTION

Lecture/Discussion: Overview of Course, Structure & Ideas + Case Studies

HW: Read/Respond:

Marr, Bernard. "What Is Extended Reality Technology? A Simple Explanation For Anyone," New York Times.

Benford, Steve and Gabriella Giannachi. *Performing Mixed Reality*, Introduction.

Marco Gillies, "Mixed Reality Immersive Theatre."

Conditt, Jess. "100 Years of Motion Capture Technology: From Snow White to Siren," Medium.

Eckert, Stephen. "What Is Immersive Theater?" Contemporary Performance.

Esteves, Augusto. "Is VR the Future of Live Performance?" The Theater Times.

HW: Experience/Deconstruct:

Royal Shakespeare Company (Dreams)

Heidi Boisvert & Kat Mustatea (Lizardly)

Kiira Ben-zing (Love Seat)

// Week 2 - Friday, September 2nd, Augmented Reality - Past & Present

Lecture/Discussion: Media Archeology of XR Devices in Storytelling and Performance

HW: Read/Respond 2:

Javornik, Ana. "The Mainstreaming of Augmented Reality: A Brief History."

Dickson, Andrew. "Augmented Reality Theater Takes Bow in Your Kitchen."

Haejin, Lee. "Imagined Odyssey: Live Mixed Reality Dance Performance."

HW: Experience/Deconstruct:

MapDesign Lab (HEROS: A Duet in Mixed Reality)

National Theatre of London (All Kinds of Limbo)

Diego Galafassi (Breathe)

Case Western Reserve University (Imagined Odyssey)

GUEST: Melissa Painter, Founder, Breakthru & Map Design Lab - AR & Dance

// Week 3 - Friday, September 9th, Augmented Reality - Tools & Techniques

Overview/Demo: Unity + ARKit

In Class Exercise 1: Making Marker & Markerless AR for Mobile Devices

HW: Review Tutorials: Unity & ARKit

// Week 4 - Friday, September 16th, Augmented Reality - Prototyping

Project 1 - Augmented Reality Performance

HW: Submit Documentation to GitHub

// Week 5 - Friday, September 23rd - Virtual Reality - Past & Present

Lecture/Discussion: Cyberspace & the Neurobiology and Metaphysics of XR

GUEST: Mileca Sec, Co-Founder, New Reality Company — VR & Working with Actors

HW: Read/Respond:

Seo, J. "Aesthetics of Immersion in Interactive Immersive."

Rheingold, H. "The Ontology of Cyberspace in Virtual Reality: Exploring the Brave New Technologies."

Herrera, F., & Bailenson, J. N. (2021). Virtual reality perspective-taking at scale: Effect of avatar representation, choice, and head movement on prosocial behaviors. *NEW MEDIA & SOCIETY*, 23(8), 2189–2209.

Martingano, Alison Jane et al. "Virtual Reality Improves Emotion, but Not Cognitive Empathy: A Meta-Analysis."

HW: Experience/Deconstruct:

BeAnother Lab (Body Swap)

Felix & Paul (The Infinite)

Hyphen Labs (NeuroSpeculative AfroFeminism)

CloudRed (Queer Skins: A Love Story)

// Week 6 - Friday, September 30th - Virtual Reality - Tools & Techniques

Overview/Demo: Unity + Oculus

Lab/In Class Exercise 2: Level Design & Ambisonic Sound

HW: Review Tutorials: Unity & Oculus

// Week 7 - Friday, October 7th - Virtual Reality - Prototyping

Project 2: Create a Set & Scene inside Unity for a Live Performance inside VR

HW: Submit Documentation to GitHub

// Week 8 - Friday, October 14th - Motion Capture - Past & Present

Lecture/Discussion: Motion Capture for Games, Films & Live Performance

GUEST: Sandra Rodriguez, Producer, Eyesteel Productions - Live Motion Capture for Mixed Reality

HW: Read/Respond:

Pezzulo, Giovanni and Barsalou, Lawrence. "The mechanics of embodiment: a dialog on embodiment and computational modeling."

Walton, Robert Ellis. "Theatres of Artificial Intelligence and the Overlooked Performances of Computing."

Boucher, Marc. "Virtual Dance and Motion Capture."

Munster, Anna. *Materializing New Media: Embodiment in Information Aesthetics*, Chapter 3 (p. 86-116).

HW: Experience/Deconstruct:

Gibson & Martelli (Dazzle & Expanded Fields)

Sandra Rodriguez, Alexander Whitley (Future Rites)

MCCS Goldsmiths (Dancing into the Metaverse)

National Theatre of London (Draw Me Close)

// Week 9 - Friday, October 21st - Motion Capture - Tools & Techniques

Overview/Demo: Rokoko - Motion Capture for Animation and Live Stream

Lab/In Class Exercise 3: Real-Time Retargeting to a 3D Avatar inside Unity

HW Tutorials: Rokoko Studio

// Week 10 - Friday, October 21st - Motion Capture - Prototyping

Project 3: 2 Person Live MoCap Performance inside Unity

HW: Submit Documentation to GitHub

// Week 11 - Friday, October 28th - Photogrammetry & Volumetric Capture

Demo: Other Techniques for Capturing 3D Imagery into Game Engines

In Class Exercise 4: 3D Scanning Bodies in Space

HW Read/Respond:

Cizek, Kat and William Urrichio. "Co-Creating with Non-Humans" (from *Collective Wisdom*).

Babich, N, *The Role of Storyboarding in UX Design*, 10/25/2017.

HW Experience Deconstruction:
Scatter (Zero Days VR)
United Nations (The Last Goodbye)

HW Tutorials: MetaScan & DepthKit

// Week 12 - Friday, November 4th - Bringing it All Together: Co-Creation Workshop & Concept Development

Studio: PROJECT DEVELOPMENT: EXPERIENCE DESIGN

// Week 13 - Friday, November 11th

Studio: PROJECT DEVELOPMENT: ASSET CREATION

// Week 14 - Friday, November 18th

Studio: PROJECT DEVELOPMENT: PROGRAMMING

HOLIDAY - NO CLASS - NOVEMBER 25th

// Week 15 - Friday, December 2nd

Studio: PROJECT DEVELOPMENT: TESTING & ITERATION

// Week 16 - Friday, December 10th

FINAL PRESENTATIONS: PERFORMANCES

FINAL DOCUMENTATION DUE - December 12th

PROJECTS:

MID-TERM - WRITE A JOURNAL ARTICLE (2-3 pages) informed by experience deconstructions.

FINAL - CREATE A SHORT MIXED REALITY PERFORMANCE (10-15 minutes) employing motion capture, virtual or augmented reality technology and centering the body as a driver of the experience.

Additional Campus Resources:

Health and Wellness

U Matter, We Care: If you or someone you know is in distress, please contact umatter@ufl.edu, 352-392-1575, or visit [U Matter, We Care website](#) to refer or report a concern and a team member will reach out to the student in distress.

Counseling and Wellness Center: [Visit the Counseling and Wellness Center website](#) or call 352-392-1575 for information on crisis services as well as non-crisis services.

Student Health Care Center: Call 352-392-1161 for 24/7 information to help you find the care you need, or [visit the Student Health Care Center website](#).

University Police Department: [Visit UF Police Department website](#) or call 352-392-1111 (or 9-1-1 for emergencies).

UF Health Shands Emergency Room / Trauma Center: For immediate medical care call 352-733-0111 or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32608; [Visit the UF Health Emergency Room and Trauma Center website](#).

GatorWell Health Promotion Services: For prevention services focused on optimal wellbeing, including Wellness Coaching for Academic Success, visit the [GatorWell website](#) or call 352-273-4450.

Academic Resources

E-learning technical support: Contact the [UF Computing Help Desk](#) at 352-392-4357 or via e-mail at helpdesk@ufl.edu.

Career Connections Center: Reitz Union Suite 1300, 352-392-1601. Career assistance and counseling services.

Library Support: Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center: Broward Hall, 352-392-2010 or to make an appointment 352-392-6420. General study skills and tutoring.

Writing Studio: 2215 Turlington Hall, 352-846-1138. Help brainstorming, formatting, and writing papers.

Student Complaints On-Campus: [Visit the Student Honor Code and Student Conduct Code webpage for more information.](#)

On-Line Students Complaints: [View the Distance Learning Student Complaint Process.](#)