Stanford

Sean Follmer

Assistant Professor of Mechanical Engineering and, by courtesy, of Computer Science

Bio

BIO

Sean Follmer is an Assistant Professor of Mechanical Engineering and Computer Science (by courtesy) at Stanford University. His Research in Human Computer Interaction, Haptics, and Human Robot Interaction explores the design of novel tactile physical interfaces and novel robotic devices. Dr. Follmer directs the Stanford Shape Lab and is a faculty member of the Stanford HCI Group. He is a core faculty member of the Design Impact masters program focusing on innovation and human centered design at Stanford.

The Shape lab explores how we can interact with digital information in a more physical and tangible way. Towards our goal of more human centered computing, we believe that interaction must be grounded in the physical world and leverage our innate abilities for spatial cognition and dexterous manipulation with our hands. We develop advanced technologies in robotics, mechatronics, and sensing to create interactive, dynamic physical 3D displays and haptic interfaces that allow 3D information to be touched as well as seen. We are specifically interested in using these novel interfaces to support richer remote collaboration, computer aided design, education, and interfaces for people with visual impairments. In pursuit of these goals, we use a design process grounded in iterative prototyping and human centered design and look to create new understanding about human perception and interaction through controlled studies.

Our research in Human Computer Interaction and Human Machine Interaction currently directed the following areas:

- Shape Changing and Tangible User Interfaces
- Haptic Interaction
- Accessible User Interfaces for People who Are Blind and Visually Impaired
- Shape Changing Robotics
- Design and Debugging Tools for Physical Computing and Robotic Systems

Dr. Follmer received a PhD and a Masters from the MIT Media Lab in 2015 and 2011 (respectively) for his work in human-computer interaction, and a BS in Engineering with a focus on Product Design from Stanford University. His talk featured on TED.com was named one of the best science and tech TED talks of 2015 and has been viewed more than 1.5 million times. He has received numerous awards for his research and design work such as an Alfred P. Sloan Fellowship, NSF CAREER Award, Google Faculty Research Award, 17 Best Paper Awards and nominations from premier conferences in human-computer interaction (including Five Best papers at ACM UIST, One Best Paper at ACM CHI and an IMWUT Distinguished Paper Award), Fast Company Innovation By Design Award, Red Dot Design Award, and a Laval Virtual Award. His work has been shown at the Smithsonian Cooper Hewitt Design Museum, Ars Electronica Center, and the Milan Design Week.

ACADEMIC APPOINTMENTS

- Assistant Professor, Mechanical Engineering
- Member, Bio-X
- Faculty Affiliate, Institute for Human-Centered Artificial Intelligence (HAI)

HONORS AND AWARDS

- NSF CAREER Award, National Science Foundation (2022)
- Best Paper Award, ACM CHI 2021 (2021)
- Sloan Research Fellowship, Alfred P. Sloan Foundation (2021)
- Best Short Paper Award, ACM VRST (2019)
- Distinguished Paper Award, ACM IMWUT Volume 2 (2019)
- Best Paper Award, ACM UIST 2017 (2017)
- Google Faculty Research Award, Google (2017)
- Best Demo Award, ACM UIST 2016 (2016)
- Best Paper Award (x2), ACM UIST 2016 (2016)
- Google Faculty Research Award, Google (2016)
- Best Paper Award, ACM UIST 2013 (2013)
- Best Paper Award, ACM UIST 2012 (2012)

PROGRAM AFFILIATIONS

- Symbolic Systems Program

PROFESSIONAL EDUCATION

- Postdoctoral Associate, MIT Media Lab (2015)
- PhD, MIT Media Lab (2015)
- S.M., MIT Media Lab (2011)

LINKS

- Shape Lab Site: http://shape.stanford.edu
- Talk on TED.com: https://www.ted.com/talks/sean_follmer_shape_shifting_tech_will_change_work_as_we_know_it

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

Human Computer Interaction, Haptics, Robotics, Human Centered Design

Teaching

COURSES

2021-22

- Human-Computer Interaction Seminar: CS 547 (Aut)
- Product Design Methods: ME 115B (Win)

2020-21

- Design Impact Master's Project I: ME 316A (Aut)
- Design Impact Master's Project II: ME 316B (Win)
- Design Impact Master's Project III: ME 316C (Spr)
- Product Design Methods: ME 115B (Spr)

2019-20

- Design Impact Master's Project I: ME 316A (Aut)
- Introduction to the Design of Smart Products: CS 377N, ME 216M (Spr)
- Product Design Methods: ME 115B (Win)

2018-19

- Design Impact Master's Project I: ME 316A (Aut)
- Introduction to the Design of Smart Products: ME 216M (Spr)
- Product Design Methods: ME 115B (Win)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Elyse Chase, Brian Do, Lawrence Domingo, Millie Salvato

Orals Chair

Will Crichton, Griffin Dietz

Doctoral Dissertation Advisor (AC)

Elyse Chase, Savannah Cofer, Eric Gonzalez, Wing-Sum Law, Ahad Rauf, Elizabeth Vasquez

Doctoral Dissertation Co-Advisor (AC)

Parastoo Abtahi, Eunyoung Kim, Jingyi Li

Master's Program Advisor

Gabriella Dweck, Blake Hord, Ayisha Jackson, Shanduojiao Jiang, Julie Liu, Antonio Medina Perez, Laura Schuetz, Jasmine Shih, Liliana Taylor, Michelle Xu

Doctoral (Program)

Dan Fan, Dan Ilyin, Alessandra Napoli, Sofia Wyetzner

Publications

PUBLICATIONS

- **Augmenting Perceived Softness of Haptic Proxy Objects Through Transient Vibration and Visuo-Haptic Illusion in Virtual Reality** *IEEE TRANSACTIONS ON VISUALIZATION AND COMPUTER GRAPHICS*
  Choi, I., Zhao, Y., Gonzalez, E. J., Follmer, S.
  2021; 27 (12): 4387-4400
- **Generating Legible and Glanceable Swarm Robot Motion through Trajectory, Collective Behavior, and Pre-attentive Processing Features** *ACM TRANSACTIONS ON HUMAN-ROBOT INTERACTION*
  Kim, L. H., Follmer, S.
  2021; 10 (3)
- **Hybrid Actuation With Unidirectional Clutches for Handheld Haptic Controllers** *IEEE ROBOTICS AND AUTOMATION LETTERS*
  Choi, I., Gonzalez, E. J., Follmer, S.
  2021; 6 (3): 4827-4834

- **HIGH FORCE DENSITY MULTI-STAGE ELECTROHYDRODYNAMIC JETS USING FOLDED LASER MICROFABRICATED ELECTRODES**
  Drew, D. S., Follmer, S., IEEE
  IEEE.2021: 54-57
- **Balloon Animal Robots: Reconfigurable Isoperimetric Inflated Soft Robots**
  Stuart, A. D., Hammond, Z. M., Follmer, S., IEEE
  IEEE.2021: 6941-6947
- **Grasp Analysis and Manipulation Kinematics for Isoperimetric Truss Robots**
  Hammond, Z. M., Usevitch, N. S., Follmer, S., IEEE
  IEEE.2021: 6140-6146
- **Acoustic Communication and Sensing for Inflatable Modular Soft Robots**
  Drew, D. S., Devlin, M., Hawkes, E., Follmer, S., IEEE
  IEEE.2021: 11827-11833
- **A Causal Feeling: How Kinesthetic Haptics Affects Causal Perception**
  Chase, E. Z., Wolff, P., Gerstenberg, T., Follmer, S., IEEE
  IEEE.2021: 347
- **Lightweight High Voltage Generator for Untethered Electroadhesive Perching of Micro Air Vehicles** *IEEE ROBOTICS AND AUTOMATION LETTERS*
  Park, S., Drew, D. S., Follmer, S., Rivas-Davila, J.
  2020; 5 (3): 4485–92
- **An untethered isoperimetric soft robot.** *Science robotics*
  Usevitch, N. S., Hammond, Z. M., Schwager, M., Okamura, A. M., Hawkes, E. W., Follmer, S.
  2020; 5 (40)
- **An untethered isoperimetric soft robot** *SCIENCE ROBOTICS*
  Usevitch, N. S., Hammond, Z. M., Schwager, M., Okamura, A. M., Hawkes, E. W., Follmer, S.
  2020; 5 (40)
- **Foxels: Build Your Own Smart Furniture**
  Perteneder, F., Probst, K., Leong, J., Gassler, S., Rendl, C., Parzer, P., Fluch, K., Gahleitner, S., Follmer, S., Koike, H., Haller, M., Assoc Comp Machinery
  ASSOC COMPUTING MACHINERY.2020: 111–22
- **User-Defined Swarm Robot Control** *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*
  Kim, L. H., Drew, D. S., Domova, V., Follmer, S.
  Association for Computing Machinery.2020: 13
- **Design and Analysis of High-Resolution Electrostatic Adhesive Brakes Towards Static Refreshable 2.5D Tactile Shape Display** *IEEE TRANSACTIONS ON HAPTICS*
  Zhang, K., Gonzalez, E. J., Guo, J., Follmer, S.
  2019; 12 (4): 470–82
- **Beyond The Force: Using Quadcopters to Appropriate Objects and the Environment for Haptics in Virtual Reality**
  Abtahi, P., Landry, B., Yang, J., Pavone, M., Follmer, S., Landay, J. A., Assoc Comp Machinery
  ASSOC COMPUTING MACHINERY.2019
- **Investigating the Detection of Bimanual Haptic Retargeting in Virtual Reality**
  Gonzalez, E. J., Follmer, S., Spencer, S. N.
  ASSOC COMPUTING MACHINERY.2019
- **shapeCAD: An Accessible 3D Modelling Workflow for the Blind and Visually-Impaired Via 2.5D Shape Displays**
  Siu, A. F., Kim, S., Miele, J. A., Follmer, S., Assoc Comp Machinery
  ASSOC COMPUTING MACHINERY.2019: 342–54
- **Tactile Code Skimmer: A Tool to Help Blind Programmers Feel the Structure of Code**
  Falase, O., Siu, A. F., Follmer, S., Assoc Comp Machinery
  ASSOC COMPUTING MACHINERY.2019: 536–38

- **Evaluating the Minimum Jerk Motion Model for Redirected Reach in Virtual Reality**
  Gonzalez, E. J., Abtahi, P., Follmer, S., ACM
  ASSOC COMPUTING MACHINERY.2019: 4–6
- **Editing Spatial Layouts through Tactile Templates for People with Visual Impairments**
  Li, J., Kim, S., Miele, J. A., Agrawala, M., Follmer, S., Assoc Comp Machinery
  ASSOC COMPUTING MACHINERY.2019
- **Pinpoint: A PCB Debugging Pipeline Using Interruptible Routing and Instrumentation**
  Strasnick, E., Follmer, S., Agrawala, M., Assoc Comp Machinery
  ASSOC COMPUTING MACHINERY.2019
- **SwarmHaptics: Haptic Display with Swarm Robots**
  Kim, L. H., Follmer, S., Assoc Comp Machinery
  ASSOC COMPUTING MACHINERY.2019
- **Dynamic Composite Data Physicalization Using Wheeled Micro-Robots.** *IEEE transactions on visualization and computer graphics*
  Goc, M. L., Perin, C., Follmer, S., Fekete, J., Dragicevic, P.
  2018
- **Electrostatic Adhesive Brakes for High Spatial Resolution Refreshable 2.5D Tactile Shape Displays**
  Zhang, K., Follmer, S., Kuchenbecker, K. J., Gerling, G. J., Visell, Y.
  IEEE.2018: 319–26
- **An Accessible CAD Workflow Using Programming of 3D Models and Preview Rendering in A 2.5D Shape Display**
  Siu, A. F., Miele, J., Follmer, S., Assoc Comp Machinery
  ASSOC COMPUTING MACHINERY.2018: 343–45
- **Investigating Tangible Collaboration for Design Towards Augmented Physical Telepresence** *DESIGN THINKING RESEARCH: MAKING DISTINCTIONS: COLLABORATION VERSUS COOPERATION*
  Siu, A. F., Yuan, S., Pham, H., Gonzalez, E., Kim, L. H., Le Goc, M., Follmer, S., Plattner, H., Meinel, C., Leifer, L.
  2018: 131–45
- **Designing Line-Based Shape-Changing Interfaces** *IEEE PERVASIVE COMPUTING*
  Nakagaki, K., Follmer, S., Dementyev, A., Paradiso, J. A., Ishii, H.
  2017; 16 (4): 36–46
- **shiftIO: Reconfigurable Tactile Elements for Dynamic Affordances and Mobile Interaction**
  Strasnick, E., Yang, J., Tanner, K., Olwal, A., Follmer, S., ACM
  ASSOC COMPUTING MACHINERY.2017: 5075–86
- **Shape Displays: Spatial Interaction with Dynamic Physical Form** *IEEE COMPUTER GRAPHICS AND APPLICATIONS*
  Leithinger, D., Follmer, S., Olwal, A., Ishii, H.
  2015; 35 (5): 5-11
- **Jamming User Interfaces: Programmable Particle Stiffness and Sensing for Malleable and Shape-Changing Devices** *UIST'12: PROCEEDINGS OF THE 25TH ANNUAL ACM SYMPOSIUM ON USER INTERFACE SOFTWARE AND TECHNOLOGY*
  Follmer, S., Leithinger, D., Olwal, A., Cheng, N., Ishii, H.
  2012: 519-528
- **TessalTable: Tile-based Creation of Patterns and Images** *4th International Conference on Tangible, Embedded and Embodies Interaction*
  Allison, A., Follmer, S., Raffle, H.
  ASSOC COMPUTING MACHINERY.2010: 203–204
- **d.note: Revising User Interfaces Through Change Tracking, Annotations, and Alternatives** *28th Annual CHI Conference on Human Factors in Computing Systems*
  Hartmann, B., Follmer, S., Ricciardi, A., Cardenas, T., Klemmer, S. R.
  ASSOC COMPUTING MACHINERY.2010: 493–502
- **Family Story Play: Reading with Young Children (and Elmo) Over a Distance** *CHI2010: PROCEEDINGS OF THE 28TH ANNUAL CHI CONFERENCE ON HUMAN FACTORS IN COMPUTING SYSTEMS, VOLS 1-4*

Raffle, H., Ballagas, R., Revelle, G., Horii, H., Follmer, S., Go, J., Reardon, E., Mori, K., Kaye, J. '., Spasojevic, M.
2010: 1583-1592