

# Rahul Arora

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## CONTACT INFORMATION

Meta Platforms  
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🏠 [rahularora.xyz](http://rahularora.xyz)  
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## RESEARCH INTERESTS

Interactive Computer Graphics  
Virtual and Augmented Realities (VR/AR)

Human-Computer Interaction (HCI)  
Applied Perception

## WORK EXPERIENCE

Research Scientist, **Reality Labs, Meta** 2021-present  
As a member of the Input Explorations team at Meta, I develop multimodal interactions for the AR/AI wearable devices of the future: see news releases on the [Orion AR glasses](#) and [the EMG wristband](#) to learn more about these technologies.

My work at Meta spans gesture design, sensing algorithms, applications of sensor fusion, and the development of prototype interfaces to showcase and evaluate these interactions. For data collection as well as quantitative evaluation of interaction schemes, I also lead the design and execution of small ( $N \approx 10$ ) and large-scale ( $N \approx 1000$ ) user studies.

## EDUCATION

*PhD, University of Toronto* 2015-2021  
Major: Computer Science  
Thesis: Creative Expression in Immersive 3D Environments  
Adviser: Prof. Karan Singh

*MTech, Indian Institute of Technology, Kanpur* 2014-2015  
Major: Computer Science and Engineering  
Thesis: Exploring Design Space by Interpolating between Multiple Sketches  
Advisers: Prof. Vinay P. Namboodiri and Dr. Adrien Bousseau

*BTech, Indian Institute of Technology, Kanpur* 2010-2015  
Major: Computer Science and Engineering

## PEER-REVIEWED PUBLICATIONS

**A Generic Noninvasive Neuromotor Interface for Human-Computer Interaction**  
CTRL-Labs at Reality Labs (245 contributors including **Rahul Arora**)  
*Nature*, 2025

<https://www.nature.com/articles/s41586-025-09255-w>

**Piecewise-Smooth Surface Fitting onto Unstructured 3D Sketches**  
Emilie Yu, **Rahul Arora**, J. Andreas Bærentzen, Karan Singh, and Adrien Bousseau  
*ACM Transactions on Graphics (TOG) 2022, proc. SIGGRAPH*  
[https://em-yu.github.io/research/surfacing\\_3d\\_sketches/](https://em-yu.github.io/research/surfacing_3d_sketches/)

**Mid-Air Drawing of Curves on 3D Surfaces in Virtual Reality**  
**Rahul Arora** and Karan Singh  
*ACM Transactions on Graphics (TOG) 2021, presented at SIGGRAPH 2021*  
[http://bit.ly/tog21\\_mimicry](http://bit.ly/tog21_mimicry)

**CASSIE: Curve and Surface Sketching in Immersive Environments**  
Emilie Yu, **Rahul Arora**, Tibor Stanko, J. Andreas Bærentzen, Karan Singh, and Adrien

Bousseau

*ACM SIGCHI Conference on Human Factors in Computing Systems 2021 (CHI '21)*

🏆 **Best Paper Honorable Mention**

<https://em-yu.github.io/research/cassie/>

### **MagicalHands: Mid-Air Hand Gestures for Animating in VR**

**Rahul Arora**, Rubaiat Habib Kazi, Danny Kaufman, Wilmot Li, and Karan Singh

*ACM Symposium on User Interface Software and Technology 2019 (UIST '19)*

<https://www.dgp.toronto.edu/projects/magical-hands/>

### **Volumetric Michell Trusses for Parametric Design & Fabrication**

**Rahul Arora**, Alec Jacobson, Timothy R. Langlois, Yijiang Huang, Caitlin Mueller, Wojciech Matusik, Ariel Shamir, Karan Singh, and David I.W. Levin

*ACM Symposium on Computational Fabrication 2019 (SCF '19)*

<https://www.dgp.toronto.edu/projects/michell/>

### **SymbiosisSketch: Combining 2D and 3D Sketching for Designing Detailed 3D Objects in Situ**

**Rahul Arora**, Rubaiat Habib Kazi, Tovi Grossman, George Fitzmaurice, and Karan Singh

*ACM SIGCHI Conference on Human Factors in Computing Systems 2018 (CHI '18)*

<https://doi.org/10.1145/3328939.3328999>

### **Experimental Evaluation of Sketching on Surfaces in VR**

**Rahul Arora**, Rubaiat Habib Kazi, Fraser Anderson, Tovi Grossman, Karan Singh, and George Fitzmaurice

*ACM SIGCHI Conference on Human Factors in Computing Systems 2017 (CHI '17)*

<http://dx.doi.org/10.1145/3025453.3025474>

### **SketchSoup: Exploratory Ideation using Design Sketching**

**Rahul Arora**, Ishan Darolia, Vinay P. Namboodiri, Karan Singh, and Adrien Bousseau

*Computer Graphics Forum (CGF) 2017, presented at Eurographics 2017*

<http://dx.doi.org/10.1111/cgf.13081>

### **Derandomizing Isolation Lemma for $K_{3,3}$ -free and $K_5$ -free Bipartite Graphs**

**Rahul Arora**, Ashu Gupta, Rohit Gurjar, and Raghunath Tewari

*Symposium on Theoretical Aspects of Computer Science (STACS) 2016*

<http://dx.doi.org/10.4230/LIPIcs.STACS.2016.10>

## **OTHER PUBLICATIONS**

### **Introduction to 3D Sketching (Invited Book Chapter)**

**Rahul Arora**, Mayra Donaji Barrera Machuca, Philipp Wacker, Daniel Keefe, and Johann Habakuk Israel

*In Interactive Sketch-Based Interfaces and Modelling for Design (ed. Alexandra Bonnici and Kenneth P. Camilleri). River Publishers. 2023.*

<https://dx.doi.org/10.1201/9781003360650-8>

### **Input Processing and Geometric Representations for 3D Sketches (Invited Book Chapter)**

Johann Habakuk Israel, Mayra Donaji Barrera Machuca, **Rahul Arora**, Philipp Wacker, and Daniel Keefe

*In Interactive Sketch-Based Interfaces and Modelling for Design (ed. Alexandra Bonnici and Kenneth P. Camilleri). River Publishers. 2023.*

<https://dx.doi.org/10.1201/9781003360650-9>

### **Interaction Devices and Techniques for 3D Sketching (Invited Book Chapter)**

Mayra Donaji Barrera Machuca, **Rahul Arora**, Philipp Wacker, Daniel Keefe, and Johann Habakuk Israel

*In Interactive Sketch-Based Interfaces and Modelling for Design* (ed. Alexandra Bonnici and Kenneth P. Camilleri). River Publishers. 2023.

<https://dx.doi.org/10.1201/9781003360650-10>

### **3D Sketching Application Scenarios (Invited Book Chapter)**

Philipp Wacker, **Rahul Arora**, Mayra Donaji Barrera Machuca, Daniel Keefe, and Johann Habakuk Israel

*In Interactive Sketch-Based Interfaces and Modelling for Design* (ed. Alexandra Bonnici and Kenneth P. Camilleri). River Publishers. 2023.

<https://dx.doi.org/10.1201/9781003360650-11>

### **Thinking Outside the Lab: VR Size & Depth Perception in the Wild (Preprint)**

**Rahul Arora**, Jiannan Li, Gongyi Shi, Karan Singh

<https://arxiv.org/2105.00584>

### **Creative Expression with Immersive 3D Interactions (Juried)**

**Rahul Arora**

*Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems (CHI '20 Doctoral Consortium)*

<https://dl.acm.org/doi/10.1145/3334480.3375028>

### **Designing Volumetric Truss Structures for Computational Fabrication (Juried)**

**Rahul Arora**, Alec Jacobson, Timothy R. Langlois, Karan Singh, and David I.W. Levin

*Graphics Interface 2018 Posters (GI '18)*

<https://bit.ly/3lCTjtw>

## **PATENTS**

### **Occlusion Avoidance of Virtual Objects in an Artificial Reality Environment**

Chenxin Hong, Philipp Schoessler, Bruno de Araujo, **Rahul Arora**, Justin Ryan Reid, and Dan Kun-yi Chen

*US Patent Application US20250200904A1, published 2025*

<https://patents.google.com/patent/US20250200904A1/en>

### **Techniques for using in-air wrist-roll gestures detected via a wrist-wearable device to operate another device, and wearable devices and systems for performing those techniques**

Christopher Anderson, **Rahul Arora**, and Julian Andres Ramos Rojas

*US Patent Application US20250106498A1, published 2025*

<https://patents.google.com/patent/US20250106498A1/en>

### **Computer-aided techniques for designing detailed three-dimensional objects**

Karansher Singh, Tovi Grossman, Kazi Rubaiat Habib, George Fitzmaurice, and **Rahul Arora**

*US Patent US11074747B2, granted 2021*

<https://patents.google.com/patent/US11074747B2/en>

## **AWARDS AND RECOGNITION**

CHI Best Paper Honorable Mention Award	2021
Robert C. Lansdale/Okino Computer Graphics Fellowship: CA \$4,000	2020
Wolfond Scholarship in Wireless Information Technology: CA \$10,000	2019
UofT Libraries Grad Exhibit Competition (3 winners): CA \$1,000	2019
Adobe Research Fellowship 2019 (11 fellows): US \$10,000	2018

	Adobe Research Fellowship 2018 Finalist	2017
	Mitacs Accelerate Award for industrial partnership: CA \$15,000	2016
	Merit-cum-Means Scholarship, IIT Kanpur: Full tuition amount	2010–2014
	Academic Excellence Award, IIT Kanpur (top 5% students)	2013
<b>INTERNSHIPS</b>	<b>Adobe Research, Seattle, USA</b> <i>with Timothy Langlois, Danny Kaufman, and Rubaiat Habib</i> Worked on techniques for creating stylized animations of 2D fluids.	Summer 2019
	<b>Adobe Research, Seattle, USA</b> <i>with Wil Li, Rubaiat Habib, and Danny Kaufman</i> Studied gestural methods for authoring animations in VR.	Summer 2018
	<b>Autodesk Research, Toronto, Canada</b> <i>with Rubaiat Habib and Tovi Grossman</i> Developed an augmented reality tool for 3D concept sketching.	Winter 2017
	<b>Autodesk Research, Toronto, Canada</b> <i>with Tovi Grossman, Rubaiat Habib, and Fraser Anderson</i> Conducted lab experiments to understand 3D sketching ability.	Summer 2016
	<b>Inria, Sophia-Antipolis, France</b> <i>with Adrien Bousseau</i> Developed a user-guided method for ideation sketch interpolation.	Summer 2014
	<b>Adobe Research, Bangalore, India</b> <i>with Ramesh Srinivasaraghavan</i> Built a gamified crowdsourcing platform for object recognition tasks.	Summer 2013
<b>SKILLS</b>	<b>Programming:</b> C#, Python, Unity Engine, MATLAB, C++, TypeScript.	
	<b>Techniques:</b> 3D graphics, numerical optimization, geometry processing, quantitative studies, qualitative studies, statistical analysis, eye tracking, inertial measurement units (IMUs).	
	<b>Tools:</b> Adobe Photoshop, Blender, Adobe Premiere, L <sup>A</sup> T <sub>E</sub> X, Microsoft Office.	
<b>TALKS</b>	<b>New York University HCI Course, Remote Talk</b> On Immersive 3D Sketching and Modelling	November 2023
	<b>Université de Montréal HCI Course, Remote Talk</b> On Immersive 3D Sketching and Modelling	April 2022
	<b>Toronto Geometry Colloquium, Remote Talk</b> <a href="#">On Human-Centered Graphics for Immersive Creative Expression</a>	October 2021
	<b>SIGGRAPH 2021, Remote Talk</b> <a href="#">Paper presentation: Mid-Air Drawing of Curves on 3D Surfaces in Virtual Reality</a>	August 2021
	<b>Autodesk Research, Remote Talk</b> On Human-Centered Graphics for Immersive Creative Expression	April 2021

<b>Facebook Reality Labs, Remote Talk</b> On Human-Centered Graphics for Immersive Creative Expression	April 2021
<b>UBC AR/VR Course, Remote Guest Lecture</b> On Gesture-Based Animation in VR	March 2021
<b>GraphDeco Group, Inria Sophia-Antipolis, Remote Talk</b> On Human-Centered Graphics for Immersive Art & Design	March 2021
<b>MIT Computer Graphics Group, Remote Talk</b> On Volumetric Michell Trusses	December 2020
<b>CHI 2020 Doctoral Symposium, Remote Talk</b> On Creative Expression with Immersive 3D Interactions	May 2020
<b>Motograph Workshop, Waterloo, Canada</b> On Stylized Fluid Animation	December 2019
<b>UIST 2019, New Orleans, USA</b> <a href="#">Paper presentation: MagicalHands</a>	October 2019
<b>SCF 2019, Pittsburgh, USA</b> <a href="#">Paper presentation: Volumetric Michell Trusses for Parametric Design &amp; Fabrication</a>	June 2019
<b>CHI 2018, Montreal, Canada</b> <a href="#">Paper presentation: SymbiosisSketch</a>	May 2018
<b>Toronto SIGCHI Chapter, Toronto, Canada</b> On Hybrid 2D–3D Sketching in SymbiosisSketch	March 2018
<b>Tomograph Workshop, Toronto, Canada</b> On Truss Topology Optimization for Design & Manufacturing	December 2017
<b>IIT Kanpur, India</b> On 2D Sketching and Immersive 3D Sketching	May 2017
<b>CHI 2017, Denver, USA</b> Paper presentation: Experimental Evaluation of Sketching on Surfaces in VR	May 2017
<b>Eurographics 2017, Lyon, France</b> Paper presentation: SketchSoup	May 2017

## SERVICE

- Committee Member** for CHI 2022 and 2023 Late-Breaking Work.
- Committee Member** for ICCV 2021 Workshop on Sketching for Human Expressivity.
- Committee Member** for Pacific Graphics 2021 and 2022.
- Committee Member** for SIGGRAPH Asia 2020 XR Program.
- Area Chair** for Graphics Interface (GI) 2020.
- Student Volunteer** at User Interface Software and Technology (UIST) 2019.

**Reviewer** for computer graphics conferences

SIGGRAPH 2020, 2022–2025; SIGGRAPH Asia 2020–2024; SIGGRAPH Posters Program 2021; Eurographics (EG) Short Papers 2021; Symposium for Computational Fabrication (SCF) 2020; Pacific Graphics 2021–2022; Graphics Interface (GI) 2018, 2020.

**Reviewer** for computer graphics journals

Transactions on Graphics (TOG) 2021; Computer Graphics Forum (CGF) 2020, 2023–2024; Transactions on Visualization and Computer Graphics (TVCG) 2019–2020, 2023, 2025; Computer-Aided Design (CAD) 2019; Computer & Graphics 2019; Computer Graphics & Applications 2017.

**Reviewer** for HCI conferences

Conference on Human Factors in Computing Systems (CHI) 2017–2025; User Interfaces Software and Technology (UIST) 2018–2020, 2022–2024; Designing Interactive Systems (DIS) 2018; Creativity & Cognition 2022; Graphics Interface (GI) 2020.

**Reviewer** for HCI journals

International Journal of Human-Computer Interaction (IJHCI) 2018; International Journal of Human-Computer Studies (IJHCS) 2021.

**Reviewer** for specialized VR/AR conferences

Virtual Reality (IEEE VR) 2018, 2020–2023; Virtual Reality Software and Technology (VRST) 2020; International Symposium on Mixed and Augmented Reality (ISMAR) 2020–2022; Spatial User Interaction (SUI) 2017.

**Reviewer** for other venues

Springer Nature Applied Sciences (SNAS) 2019.

**TEACHING  
EXPERIENCE**

<b>Computer Graphics</b> , University of Toronto Teaching Assistant for Prof. David Levin	Winter 2020
<b>Computer Graphics</b> , University of Toronto Teaching Assistant for Prof. Alec Jacobson	Fall 2019
<b>Computer Graphics</b> , University of Toronto Teaching Assistant for Prof. David Levin	Winter 2019
<b>Computer Graphics</b> , University of Toronto Teaching Assistant for Prof. Karan Singh and Prof. David Levin	Winter 2018
<b>Computer Graphics</b> , University of Toronto Teaching Assistant for Prof. Karan Singh and Prof. Alec Jacobson	Fall 2017
<b>Intro to Theory of Computation</b> , University of Toronto Teaching Assistant for Prof. Azadeh Farzan	Fall 2015
<b>Introduction to Computer Graphics</b> , IIT Kanpur Teaching Assistant for Prof. Vinay P. Namboodiri	Fall 2014