

Rahul Arora

CONTACT INFORMATION

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RESEARCH INTERESTS

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

Human-Computer Interaction (HCI)
Applied Perception

EDUCATION

PhD, University of Toronto 2015-Present
Major: Computer Science
Thesis: Creative Expression in Immersive 3D Environments
Adviser: Prof. Karan Singh
CGPA: 4.0/4.0

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
CGPA: 9.6/10.0

BTech, Indian Institute of Technology, Kanpur 2010-2015
Major: Computer Science and Engineering
CGPA: 8.5/10.0

PEER-REVIEWED PUBLICATIONS

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

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**

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>

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). River Publishers. In press.

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). River Publishers. In press.

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). River Publishers. In press.

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). River Publishers. In press.

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/3iCTjtw>

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

INTERNSHIPS

Adobe Research, Seattle, USA with Timothy Langlois, Danny Kaufman, and Rubaiat Habib Worked on techniques for creating stylized animations of 2D fluids.	Summer 2019
Adobe Research, Seattle, USA with Wil Li, Rubaiat Habib, and Danny Kaufman Studied gestural methods for authoring animations in VR.	Summer 2018
Autodesk Research, Toronto, Canada with Rubaiat Habib and Tovi Grossman Developed an augmented reality tool for 3D concept sketching.	Winter 2017
Autodesk Research, Toronto, Canada with Tovi Grossman, Rubaiat Habib, and Fraser Anderson Conducted lab experiments to understand 3D sketching ability.	Summer 2016
Inria, Sophia-Antipolis, France with Adrien Bousseau Developed a user-guided method for ideation sketch interpolation.	Summer 2014
Adobe Research, Bangalore, India with Ramesh Srinivasaraghavan Built a gamified crowdsourcing platform for object recognition tasks.	Summer 2013

SKILLS

Programming: MATLAB, C#, Unity Engine, C++, Python (limited experience).

Techniques: 3D graphics, numerical optimization, geometry processing, physical simulation, quantitative studies, qualitative studies, statistical analysis.

Tools: Adobe Photoshop, Blender, Adobe Premiere, L^AT_EX, Microsoft Office.

TALKS

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

SERVICE

- Committee Member** for ICCV 2021 Workshop on Sketching for Human Expressivity.
- Committee Member** for Pacific Graphics 2021.
- 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; SIGGRAPH Asia 2020–2021; SIGGRAPH Posters Program 2021; Eurographics (EG) Short Papers 2021; Symposium for Computational Fabrication (SCF) 2020; Pacific Graphics 2021; Graphics Interface (GI) 2018, 2020.

Reviewer for computer graphics journals

Computer Graphics Forum (CGF) 2020; Transactions on Visualization and Computer Graphics (TVCG) 2019–2020; Computer-Aided Design (CAD) 2019; Computer & Graphics 2019; Computer Graphics & Applications 2017.

Reviewer for HCI conferences

Conference on Human Factors in Computing Systems (CHI) 2017–2021; User Interfaces Software and Technology (UIST) 2018–2020; Designing Interactive Systems (DIS) 2018; 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, 2021; Virtual Reality Software and Technology (VRST) 2020; International Symposium on Mixed and Augmented Reality (ISMAR) 2020–2021; Spatial User Interaction (SUI) 2017.

Reviewer for other venues

Springer Nature Applied Sciences (SNAS) 2019.

TEACHING EXPERIENCE

Computer Graphics, University of Toronto
Teaching Assistant for Prof. Alec Jacobson Fall 2019

Computer Graphics, University of Toronto
Teaching Assistant for Prof. David Levin Winter 2019

Computer Graphics, University of Toronto
Teaching Assistant for Prof. Karan Singh and Prof. David Levin Winter 2018

Computer Graphics, University of Toronto
Teaching Assistant for Prof. Karan Singh and Prof. Alec Jacobson Fall 2017

Intro to Theory of Computation, University of Toronto
Teaching Assistant for Prof. Azadeh Farzan Fall 2015

Introduction to Computer Graphics, IIT Kanpur
Teaching Assistant for Prof. Vinay P. Namboodiri Fall 2014

REFERENCES

Karan Singh Professor, University of Toronto	https://www.dgp.toronto.edu/~karan karan@dgp.toronto.edu
David IW Levin Assistant Professor, University of Toronto	http://www.cs.toronto.edu/~diwlevin diwlevin@cs.toronto.edu
Tovi Grossman Assistant Professor, University of Toronto Distinguished Visiting Scientist, Autodesk	https://www.tovigrossman.com tovi@dgp.toronto.edu
Rubaiat Habib Kazi Senior Research Scientist, Adobe	https://rubaiathabib.me rubaiat@adobe.com
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