

Dustin Freeman

dustinfreeman.org — *dustin@cs.toronto.edu*

PERSONAL STATEMENT

I lead tech development for emerging platforms: Spatial Computing, Wearables, Telepresence. My background is academic, but I've spent significant time as an engineering generalist and founder in the venture-backed startup world. I've founded two companies in the telepresence live performance space. I finished a PhD at the University of Toronto in May 2015, during which I published 9 academic papers and 4 patents.

Almost every new role I've started has required me to learn, and then teach, a new technique or technology. I have extensive background building gestural interaction/3D spatial computing systems, so unlike someone more junior, I don't get stuck in traditional metaphors. I've used several Computer Vision/Deep Learning systems, and implemented algorithms described only in white papers. I have extensive experience building for new platforms in Unity, C++ (SFML/OpenGL), C# (WPF/XNA), Objective-C/SceneKit, HTML5/CSS/Javascript. I have done large-scale data analysis using Python and MATLAB. I have written high-performance real-time image processing code in C++ (OpenCV, CUDA-C and Obj-C with C backend). For Escape Character, I built a web backend for a multiplayer engine in Rust, and loved its compiler.

Recent Highlights:

- Advised an MSc student, and coauthored a paper on live streamed education, in ACM SIGCHI 2019.
- Founded a coworking space in Toronto May 2018. We now have 3 game dev studios as subtenants.
- Received US permanent residency ("Green Card") in March 2019

EDUCATION

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| 2015 | Ph.D. Computer Science UNIVERSITY OF TORONTO Advisor: Prof. Ravin Balakrishnan Thesis: Improv Remix: Video Manipulation Using Whole-Body Interaction To Extend Improvised Theatre Courses: Machine Learning (Hinton), Computer Graphics, HCI: Ubiquitous Computing |
| 2010 | M.Sc. Computer Science UNIVERSITY OF TORONTO Advisor: Prof. Ravin Balakrishnan Thesis: Tangible Actions: More Efficient Direct Multitouch Through Replaying Gestures |
| 2008 | B.Sc. Mathematics and Engineering QUEEN'S UNIVERSITY Advisor: Prof. Abdol-Reza Mansouri Thesis: Motion-based Image Segmentation Without Motion Computation |

PROFESSIONAL EXPERIENCE

As Employee

- Jul'19 - Dec'22 **CTRL Labs (acquired by Meta Reality Labs)** (New York City, USA)
Research Scientist. Acquired with CTRL Labs. Working on neural, gestural, spatial computing interaction research for emerging platforms. In particular, the pipeline from training data to user experience for ML gestural detection models. ctrl-labs.com
- Nov'14 - Apr'16 **Occipital** (San Francisco, USA)
Spatial Interaction Engineer. Shipped 3 major demos with new SLAM SDK functionality for tablets and Mixed Reality Bridge HMDs. Objective-C, SceneKit and Unity. occipital.com

As Founder

- May'17 - Mar'19 **Escape Character, Inc.** (Toronto, Canada)
Founder. Built platform and content for live, telepresence immersive theatre and games, staffed by professional performers. Ran over 80 live events. escape-character.com
- Jun'16 - Aug'18 **Playlines** (London, UK)
Technical Director. Built apps using Bluetooth iBeacons to create audio augmented reality narrative. playlines.net
- Dec'15 - May'17 **Raktor** (San Francisco, USA)
CTO. Built live entertainment in virtual and mixed reality with live actors. We built technologies and created events that engaged local and remote streaming audiences. raktor.org

As Contractor

- Aug - Oct 2018 **Limbix Health** (Palo Alto, USA)
Machine Learning Researcher. I explored machine learning approaches to efficiently process and reinterpret stereo 360 video of actors and environments. limbix.com
- Aug - Nov 2017 **Fantasma** (Los Angeles, USA)
ARKit Developer. Built augmented reality prototypes in Swift and Unity on iOS. Worked with the CTO to coordinate development efforts for a recently-formed team. fantasma.io
- Sep - Dec 2016 **Moatboat** (San Francisco, USA)
Unity Software Engineer. First non-founder hire, working on Moatboat's simulation-based VR creativity tool. A venture-backed Google Daydream launch partner. moatboat.com
- Jun - Aug 2016 **Secret Location** (Toronto, Canada)
Software Engineer. Integrated an Android NDK 360 video renderer for VR with the Unity for pre-release Google Cardboard and Daydream. secretlocation.com
- Aug - Sep 2014 **Globacore** (Toronto, Canada)
Contract Software Engineer. Built an OpenNI2 wrapper for pre-release Intel RealSense for body scanning and skeletal mapping for a high-throughput conference event. globacore.com

PUBLICATIONS

Chen, D., **Freeman, D.** and Balakrishnan, R. Integrating Multimedia Tools to Enrich Interactions in Live Streaming for Language Learning. ACM CHI 2019.

Freeman, D. and Balakrishnan, R. Improv Remix: Mixed-Reality Video Manipulation Using Whole-Body Interaction to Extend Improvised Theatre. ACM DIS 2016.
<http://dl.acm.org/citation.cfm?id=2901894>

Freeman, D., Jota, R., Vogel, D., Wigdor, D. and Balakrishnan, R. A Dataset of Naturally Occurring, Whole-Body Background Activity to Reduce Gesture Conflicts. arXiv 2015.
<https://arxiv.org/abs/1509.06109>

Freeman, D., Santosa, S., Chevalier, F., Balakrishnan, R., and Singh, K. LACES: Live Authoring through Compositing and Editing of Streaming Video. ACM CHI 2014.
Citation Count: 4
<http://dl.acm.org/citation.cfm?id=2557304>

Freeman, D., F. Chevalier, N. Lapierre and D. Reilly. Tweetris: A Study of Whole-Body Interaction During a Public Art Event. ACM Creativity and Cognition 2013. **Emma Candy Award Winner 2013.**
Citation Count: 10
<http://dl.acm.org/citation.cfm?id=2466627.2466650>

Freeman, D., Vennelakanti, R. and Madhvanath, S. Freehand pose-based Gestural Interaction: Studies and implications for interface design. IEEE IHCI 2012.
Citation Count: 13
<http://dl.acm.org/citation.cfm?id=2466627.2466650>

Freeman, D., Hilliges, O., Sellen, A., O'Hara, K., Izadi, S. and Wood, K. The Role of Physical Controllers in Motion Video Gaming ACM DIS 2012.
Citation Count: 11
<http://dl.acm.org/citation.cfm?id=2317956.2318063>

Freeman, D. and Balakrishnan, R. Tangible Actions. ACM ITS 2011.
<http://dl.acm.org/citation.cfm?id=2076354.2076373>

Izadi, S., Kim, D., Hilliges, O., Molyneaux, D., Newcombe, R., Kohli, P., Shotton, J., Hodges, S., **Freeman, D.**, Davison, A., and Fitzgibbon, A. KinectFusion: real-time 3D reconstruction and interaction using a moving depth camera. ACM UIST 2011.
Citation Count: 1293
10-Year Lasting Impact Award at UIST 2021
<http://dl.acm.org/citation.cfm?id=2047196.2047270>

Freeman, D., Benko, H., Ringel-Morris, M. & Wigdor, D. ShadowGuides: Visualizations for In-Situ Learning of Multi-Touch and Whole-Hand Gestures. ACM ITS 2009.
Citation Count: 126
<http://dl.acm.org/citation.cfm?id=1731935>

Book Chapter
Reilly, D., Chevalier, F. and **Freeman, D.** 2014. Blending Art Events and HCI Research. In Interactive Experience in the Digital Age, Candy, L., Ferguson, S., Ed. Springer Books.
Citation Count: 4
http://link.springer.com/chapter/10.1007%2F978-3-319-04510-8_11

INVITED TALKS, PANELS AND PRESS

Talks associated with conference papers not included.

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| Panel Host | VRTO 2019 Indie VR Game Developers: The Game Show https://conference.virtualreality.to/events/the-game-show/ |
| Podcast | ROOM ESCAPE DIVAS Dustin Freeman on Remote Immersive Design Podcast Link |
| Interview | NO PROSCENIUM Exploring Presence Through Cursors and Emojis with <i>The Aluminum Cat</i> Article Link |
| Press | CANADIAN THEATRE REVIEW Distributed Embodiment Across Time and Space: Escape Character's Ongoing Work on Creating Telepresence Participatory Experiences in Sparasso Article Link |
| Panel | VRTO 2018 VR and AR Game Design: State of the Art |
| Talk | IMMERSED 2018 A Vision for the Future of Entertainment https://tifca.com/students-night-out-program/ |
| Talk | VRDC 2017 Creating "Heads-Up" Narratives in AR: Lessons Learned (with Robert Morgan) In GDC Vault |
| Talk | VRVOICE: VIRTUAL REALITY GAMES & ENTERTAINMENT EXTRAVAGANZA http://entertainment.vrvoice.co/ |
| Panel | COMIC-CON STORYTELLING ACROSS MEDIA 2016 Comics and Technology: AR, VR, and Beyond. |
| Panel | EGLX 2016 Making Virtual Reality a Reality. |
| Talk | HACKADAY SUPERCON 2015 The Practical Experience of Designing a Theatre Experience around iBeacons. Writeup on Hackaday. |
| Talk | GAMERCAMP 2011 Tweetris: Kinect Hacking: The Love Child of Tetris and Hole In The Wall https://youtu.be/1g15EHxXZY0 |
| Talk | SIGCHI PARIS 2011 How Users Learn Wrongly From Ambiguity in Gestural Interfaces http://paris.sigchi.acm.org:88/homepage/home.php?n=Main.DustinFreemanSeminar |

GRANTS

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| 2017-2018 | ARTS & HUMANITIES RESEARCH COUNCIL UK <i>Reality Remix: Immersive</i> An ongoing group grant led by frequent collaborators of mine GibsonMartelli. Myself and 10 other researchers, dancers, and theater makers distributed across the USA, UK and Canada arranged several meetings and salons to create and critically assess performance pieces using virtual reality. http://gibsonmartelli.com/SpacePlace/2018/06/30/prototyping-vr-larping/ |
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PATENTS

Multimodal interface. Sriganesh Madhvanath, Dustin Freeman. United States Patent No. US9292112B2. Filing date: 2012-07-06. Grant date: 2016-03-22.

<https://patents.google.com/patent/US9292112B2/>

Hand pose interaction. Dustin Freeman, Sriganesh Madhvanath, Ankit Shekhawat and Ramadevi Vennelakanti. United States Patent No. US8869073B2. Filing date: 2012-07-27. Grant date: 2014-10-21.

<https://patents.google.com/patent/US8869073B2/>

Teaching gestures with offset contact silhouettes. Hrvoje Benko, Daniel J. Wigdor and Dustin Freeman. United States Patent No. US8622742B2. Filing date: 2009-11-16. Grant date: 2014-01-07.

<https://patents.google.com/patent/US8622742B2/>

INTERNSHIPS

- Spring 2011 **Microsoft Research Cambridge** (Cambridge, UK)
Internship; yielding 2 papers: *KinectFusion* and *The Role of Physical Controllers*.
Supervisors: Otmar Hilliges, Abigail Sellen, Shahram Izadi
- Summer 2010 **HP Labs India** (Bangalore, India)
Internship; yielding 1 paper: *Freehand pose-based Gestural Interaction*
Supervisor: Sriganesh Madhvanath
- Spring 2009 **Microsoft Research Redmond** (Redmond, Washington, USA)
Internship, yielding 1 paper: *ShadowGuides*
Supervisors: Hrvoje Benko, Daniel Wigdor, Meredith Ringel-Morris
- Summer 2008 **Queen's University, School of Computing** (Kingston, Canada)
NSERC USRA Award; Explored curved multitouch interfaces.
Supervisor: Prof. Roel Vertegaal, Human Media Lab
- Summer 2006 **Queen's University, Mathematics and Statistics Dept.** (Kingston, Canada)
NSERC USRA Award; Implemented Semi-definite optimization algorithms to analyze phase behaviour in high-temperature superconductivity. (MATLAB).
Supervisor: Prof. Bob Erdahl, Quantum Phases Group
- Summer 2005 **Queen's University, Mechanical Engineering Dept.** (Kingston, Canada)
Research Assistant: 1) Implemented a reactive daylighting system for a new building (Integrated Learning Centre). 2) Empirically investigated wicking in fabrics for use in fuel cells.
Supervisor: Prof. Stephen Harrison, Solar Calorimetry Lab

TEACHING

Summer 2011 **CSC 148: Introduction to Computer Science (Python)**
University of Toronto, as instructor with 4 TAs; course enrolment of 80.

TEACHING ASSISTANT

2008 - 2014 **University of Toronto**
Advised over 100 student projects from game development to interactive product design.
CSC 428: Human Computer Interaction
(for Olivier St. Cyr, Winter 2014; Fanny Chevalier, Winter 2013)
CSC 404: Game Design (for Steve Engels & Emma Westecott 2012-2014)
CSC 318: The Design of Interactive Computational Media
(for Khai Truong & Daniel Wigdor 2008-2014)
CSC 108/180: Introduction to Computer Programming in Python (Fall 2010, Fall 2013)
CSC 290: Communication Skills for Computer Scientists (Fall 2011)
CSC 165: Mathematical Expression and Reasoning (Winter 2010)
SCI 199: From Social Networks to the Internet (Fall 2008)

Fall 2011 **OCAD**
Digital Futures Technology Skills Assistance

2006 - 2008 **Queen's University**
APSC 171/172: Engineering Calculus I/II (for Leo Jonker, Fall 2006 - Winter 2008) *APSC 174: Engineering Linear Algebra* (Winter 2008)

Summer 2007 **Queen's University ONLINE PREPARATION COURSE MANAGER**
Created an online preparation course in Calculus directed at incoming engineering students who received inadequate high school math instruction.

PROFESSIONAL SERVICE

Program Advisory Committee CENTENNIAL COLLEGE, NEW MEDIA STUDIES

Judge CANADIAN VIDEO GAME AWARDS 2016

Workshop Bowers, J., Taylor, R., Hook, J., **Freeman, D.**, Bramley, C. and Newell, C. 2014. HCI: Human-Computer Improvisation. At ACM Designing Interactive Systems 2014.
<http://dl.acm.org/citation.cfm?id=2598799>

Committee CHI WORKS IN PROGRESS 2013, 2014

Reviewer for CHI 2010-2017; UIST 2011-2016; ITS 2010-2014; TEI 2011, 2017; ISS 2016; DIS 2012; GI 2014, 2016; NORDICHI 2014; MOBILE HCI 2014; IJHCS 2014

Maintainer BACKGROUND ACTIVITY DATASET <http://www.dgp.toronto.edu/~dustin/backgroundactivity/>

THEATRE, FILM, INSTALLATION

- 2019 **The Aluminum Cat** DIRECTOR, PRODUCER
Escape Character's first public release: an online ticketed game where you and 5 other are new recruits board a spaceship, and one actor plays all the characters you encounter. Writer: Natalie Zina Walschots. Performers: Stephanie Malek. Artist: Suzanna Komza. escape-character.com Review on No Proscenium
- 2018 **The Sea Shanty** PRODUCER, SET/LEVEL DESIGNER
Escape Character commissioned a performance in the Sparasso Engine for the Virtual Reality Toronto Engine. One performer would play all roles in a VR space, with 4 audience members at a time would traverse it as video game characters. Writer: Tom McGee. Performers: Kat Letwin, Anders Yates. escape-character.com
- 2016-2017 **Raktor Broadcasts** WRITER/PERFORMER/PROGRAMMER
A Mixed Reality episodic series with an in-person and remote audience over Facebook Live Video. In addition to the game engine and networking programming, Dustin played the Wizard, the Pirate Mayor, Cowboy # 2, Young Eccentricon, and the Dragon Pilot. raktor.org
- 2016 **Wizard in a Bar** WRITER/DIRECTOR
Perfomed at the San Francisco festival Come Out And Play. An immersive walking play where audience members meet a drunk wizard in a real bar, and follow the wizard's direction to meet a host of magical characters hidden throughout the city. In collaboration with Josh Marx of Floodlight Productions. <http://j-marx.com/wizard-in-a-bar/>
- 2016 **Exohistorian** PROGRAMMER/DESIGNER
A narrative space exploration game submitted to Fermijam. Writer: Cian Cruise. <https://escapecharacter.itch.io/exohistorian>
- 2016 **San Francisco Fringe Festival** PERFORMER AND PROGRAMMER
Raktor's Eccentricon. A live participatory virtual reality stage show where two over-ambitious startup idiots make an AI that grows too intelligent and alters our reality.
- 2015 **The Painting** DESIGNER AND PROGRAMMER
An immersive single-audience-member audio experience with a single actor. Set in SF's The Speakeasy, we sent audience members to find a painting while speaking to an actor over a phone. In collaboration with Josh Marx as part of Floodlight Productions.
- 2014 **Improv Remix** DESIGNER, DIRECTOR, PROGRAMMER
Presented my thesis work in the Storefront Theatre in Toronto. Worked with a Technical Director and several cast to create an interactive showcase for an audience.
- 2014 **In Search of Abandoned** PROGRAMMER, GESTURAL DESIGNER
In collaboration with artists GibsonMartelli, we developed an interactive installation in a CAVE virtual environment. Supported by CAFKA. <https://gibsonmartelli.com/portfolio/in-search-of-abandoned/>
- 2013 **POMP** PERFORMER Member of the 4-person improv troupe.
- 2012 **Brainiac Five** PERFORMER
Performed in the Toronto Fringe Festival summer 2012. Reviewed by Mooney Theatre, mentioning my character Harlan.
- 2011 **Toronto Scotiabank Nuit Blanche** PROGRAMMER FOR TWEETRIS
Tweetris, described as a combination of Tetris, Twitter and Yoga. Worked with a creative committee at OCAD, undergrad programmers from UofT and a music designer. <https://www.youtube.com/watch?v=1g15EHxXZY0>
- 2011 **Cambridge Improv Factory** REGULAR PERFORMER
improvfactory.com

Dustin Freeman

- 2008-2012 **Impatient Theatre Company** PERFORMER
Impatient Theatre Company. www.impatient.ca
Teams: Wolf Apocalypse, Iron Coffin, Mom Jeans, Calvinball
Classes: 201,202,301,401,501,601
- 2010 **Toronto Scotiabank Nuit Blanche** ARTIST FOR THE WALL
An artificial life installation inspired by John Conway's Game of Life.
Installed in the University of Toronto Art Centre.
dustinfreeman.org/blog/nuit-blanche-2010-the-wall
- 2009-2010 **Vanguard School of Comedy** LONGFORM PERFORMER
- 2008 **Nuit Blanche Post** PERFORMER - DELIVERYMAN
For the Toronto Nuit Blanche Festival
- Aug 2008 **For A Better World (translated from Freine bessere Welt)** ENSEMBLE
Single Thread Theatre Company. singlethread.ca
- Aug 2008 **Shadow Nation** JACK BISHOP
Bishop Street Films.
- 2003-2008 **The Improv Show** PERFORMER, ARTISTIC DIRECTOR (MAY 2006 - ONWARDS)
The premiere improv company in Kingston, Ontario, Canada. Activities included regular performances, external educational and corporate workshops.
- Jan 2008 **Pagliacci** SET DESIGN/CONSTRUCTION
Queen's Student Opera Company.
- Nov 2007 **Famine, by Tom Murphy** PRODUCER
Single Thread Theatre Company. Managed a cast of 20 and a production team of 25.
- July 2007 **Soft Boiled Detective Story, by Cian Cruise** LEAD VOICE ACTOR
- March 2007 **Deviants, by Jim Davies, Dustin Freeman and Talia Acker** WRITER, ACTOR, SET DESIGNER
Critical Stage Theatre Company, in collaboration with the Rhode Island School of Design.
- Jan 2007 **Supplementary Material** CAMERA OPERATOR, COLLABORATIVE WRITER/DIRECTOR
Won first prize as part of the Focus Film Festival at Queen's University.
http://www.youtube.com/watch?v=04zCGR_DgR4
- Nov 2006 **The Eumenides by Aeschylus** ORESTES, SET DESIGN/CONSTRUCTION
Directed by Tom McGee, of Chaos Theory Theatre Company, as part of Greek and Roman Drama Class. For this, I developed some innovative fake blood effects.
- March 2006 **Heterotopia, collaboratively written** WRITER, PRODUCTION MANAGER, ACTOR
Critical Stage Theatre Company. Developed over 6 months with playwright Ned Dickens.
<http://www.neddickens.com/-resume.html>
- March 2005 **Last Storey, by Alex Caspary** ACTOR
Critical Stage Theatre Company. Directed and written by Alex Caspary.
- June 2004 **Tween Eggs and Wham!** ENSEMBLE
Queen's Players. Written by the cast.
- June 2003 **Heroes, by Ken Mitchell** SUPERMAN
- June 2003 **No Exit, by Jean-Paul Sartre** DIRECTOR
I was an ambitious high school student.

OTHER ACTIVITIES

- Oct. 2009 **Scuba Diving License**
PADI Advanced Open Water Diver. Trained in Koh Tao, Thailand. Have dived in both fresh and salt water since.
- 2006-2008 **Kingston Improv Games**
HEAD TRAINER
Ran the training program for the Kingston chapter of the national Canadian Improv Games. This includes scheduling trainings and administering other trainers.
- Dec. 2004 **Mars Society Canada Expedition Alpha**
GREENHAB ENGINEER
Two-week simulation mission in the Mars Desert Research Station in Utah. Responsible for water recycling systems, and sent regular field reports to a remote team. Filmed footage that was later used on the Canadian Space Channel.
- 2000 **Aviation Focus Program**
LaSalle Secondary School in Kingston, Ontario: Constructed a four-person kitplane with a team of students.
- 1998 **Haklyut Prize: Second Place**
The Mars Society awards The Haklyut Prize to students who write essays to world leaders championing the cause of exploration of Mars.