

Sunil Hadap

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Research & Development Interests

Generative Models, Image-to-Image Translation, Variational Autoencoders, Deep Learned Manifold Traversal

Computational Imaging, Computational Photography, Depth from Defocus, Synthetic Depth of Field, Image Harmonization, Image Stitching, Flash / No-Flash Imaging

Inverse Rendering, Lighting Estimation, Camera Estimation, Depth Estimation, Decomposing Shading & Reflectance, Shape from Shading, Image Relighting

3D Shape and Material Acquisition, (Multi-view) Photometric Stereo, Image Based Modeling and Rendering, Light Field Acquisition and Rendering, Light Stage

3D Face Estimation, Face Dense Semantic Segmentation, 3DMM, Portrait Editing

Simulation based Design Tools – Bristle Brush Simulation, Watercolor and Oil Paint Simulation, Physics based Curve Editing

Innovative Apps for Tablets and Smartphones

Fluid Dynamics, Rigid Body Dynamics, Articulated Body Dynamics, Deformable Models, Cloth Simulation and Wrinkles

Real-time and Photorealistic Hair Simulation – Shape Modeling, Animation and Rendering

Real-time Graphics: Content, Dynamics and Rendering, Virtual Reality, Computer Games, Game Physics

Collision Detection & Proximity Queries, Geometric Data Structures, Computational Geometry

Numerical Methods, Parallel and Distributed Scientific Computing, General-purpose GPU Computing (GPGPU)

Mesh Registration and Fusion, Mesh Processing, Point Clouds, Constructive Solid Geometry (CSG)

3D Printing – Watertight Meshes, Casual 3D Modeling, Digital Clay

Computing Proficiency

C++11/14/17, Objective-C, STL, Boost, Git, Perforce

Matlab, Python

OpenGL, GLSL, CUDA, Metal

Qt, Cocoa, X11, Motif

Maya API, MEL, RenderMan

Education

PhD, Computer Science
MIRALab, CUI, University of Geneva, Switzerland, 2003

Master of Design, Industrial Design
Indian Institute of Technology, Bombay, India, 1995

Bachelor of Technology, Aerospace Engineering
Indian Institute of Technology, Bombay, India, 1993

Professional Experience

Principal Scientist, Adobe Dec 2015 – till date

Senior Research Scientist, Adobe Nov 2006 – Nov 2015

Senior Research Manager (Emerging Graphics Technology Group), Adobe Aug 2007 – Aug 2012

Set vision and provided thought leadership around two key themes – a) Computational Imaging b) Simulation Based Design Tools. The effort included 20+ research internships & university collaborations and 8 PhD topics through last 11 years. Product groups have always shown a keen interest in these technologies. Initiatives such as Image Relighting, 3D Face Estimation and 3D Scene Estimation push the boundaries of Computational Imaging and are poised to revolutionize aspects of digital photography and content creation. Whereas, Simulation Based Design Tools bring back the analog and serendipity of traditional media into digital world.

Established and managed a small research group at Adobe Research. Through annual strategic plans and operating plans sought funding and incremental growth. Actively recruited top-notch researchers from the diverse domain of expertise and fields of interests. Facilitated inter-group and intra-group communication, served as liaison to product groups, maintained an active relationship with academia and leading experts. Performed day-to-day managerial duties, set quarterly goals & annual plans, conducted performance reviews. Cultivated creative research environment, maintained a strong focus on shipping technologies into products.

Through my direct research contributions and under my leadership, successfully shipped the following flagship product features

- Automatic Eye Opening, Photoshop Elements and Photoshop Express, 2017
- Deep Lighting Estimation and Camera Estimation in Images, Adobe Dimension, 2017
- Watercolor Simulation on iPad, Adobe Sketch 2015 (**featured at Apple's iPad Pro launch event**)
- Realistic Simulation of Pigment Mixing (Watercolor and Copic Markers) on iPad, Adobe Sketch 2015
- Normal Estimation in an Image, Photoshop CS6
- Bristle Brush, realistic simulation of artist's brush on canvas, Photoshop & Illustrator CS5
- Wet Paint, Photoshop CS5
- Physics for Flash, Flash Pro CS5
- Inverse Kinematics and Skinning, Flash Pro CS4
- Graphics Math Library (GML), a SSE optimized small vector-matrix-quaternion library, CS4, CS5

Additionally, my research spans the following topics, many are culminating into product features

- Single Image 3D Face & Hair Estimation. Applications such as Automatic Eye Opening, Smile, Portrait Relighting, DoF Rendering, Always-Awesome-Group-Photo
- Deep Learned Manifold Traversal for Portrait Editing – relighting, gaze change, pose change, (anti) aging, removing glasses, etc.
- Structured and Un-structured Light Field Capture, Representation and Rendering. Applications to VR / AR.
- Single and Multi-View Scene Estimation – lighting, depth / geometry, material, albedo. Applications such as Image Relighting, Albedo / Material Editing, 3D Object Compositing into Real Image
- Computational Photography, Flash / No-Flash Imaging – white balance, lighting separation, light editing, denoising

Most recently, I have been busy building Light Stage for Multi-view and Photometric Stereo Acquisition

R&D Staff – simulation, PDI/DreamWorks, USA, Feb 2003 – Oct 2006

Developed a field plug-in for Maya to enable “art direction” to cloth simulations. A hand animated cloth shape serves as the input goal. The field node then drives the cloth simulation towards the animated goal, while maintaining the constraints of cloth dynamics and collisions with obstacles.

Developed and maintained in-house fluid simulation and particle animation tools.

Lead the C++ migration by developing vector math foundation library, bounding volume hierarchy template library, collision detection and proximity query library.

Developed a next generation character dynamics and visual effects primitive called Oriented Strands. Towards that, researched and developed application of differential algebraic equations to solution of stiff articulated rigid bodies, and developed a comprehensive collision response model using analytical constraints. The system is being extensively used for simulation of ears, tails, braids, foliage, long wavy/curly hair. This has been one of the most successful and futuristic projects at DreamWorks Animation.

Performed a feasibility study and developed the road-map for production strength rigid-body solver. Developed the detailed requirement specifications and an early prototype.

Research Assistant (MESH Project), MIRALab, University of Geneva, Jan 2000 – Jan 2003

European project MESH was a consortium of 4 academic and 3 industrial partners. Aim of the project was to develop tools and technologies required for animating highly realistic virtual humans. Towards this, researched and developed hairstyling, hair animation and hair rendering plug-ins to Maya. Making a paradigm shift, hair shape and hair dynamics was modeled as a fluid flow.

Research Scientist (Unilever Project), MIRALab, University of Geneva, Jan 2000 – Dec 2001

Collaborated extensively with Unilever Research, Port Sunlight, UK on hair simulation and hair care product formulation. As the project is under non-disclosure agreement, details can be made available upon request.

Research Assistant (FNRS Project), MIRALab, University of Geneva, Aug 1998 – Dec 1999

A novel method is developed to automatically compute "geometric wrinkles" on animated cloth to add that extra realism. The method can also be used for facial wrinkles.

Project Leader, Tata Elxsi (India) Ltd., Bangalore, India, Nov 1996 – Jul 1998

Managed offshore product development project for MultiGen Inc. The MultiGen Creator plug-in exports real-time content and behaviors to Nintendo and Sony Playstation. Lead the team of 7 software engineers. Managed software requirement specification, design and development, quality control and successful delivery of the product.

Senior Engineer (Systems Solution, VR), Tata Elxsi (India) Ltd., Bangalore, India, Sep 1995 – Oct 1996

Handled customer requirement specification, systems solution, customization, pilot implementation, technology demonstration, feasibility study. Got a great opportunity to innovate VR solutions for various markets such as defense, aerospace, virtual heritage, factory simulation, industrial design.

Research Assistant (IITZeus), Indian Institute of Technology, Bombay 1992-94

IITZeus project was funded by Aeronautical Development Agency, India. Developed kernel of multi-block numerical grid generation system for computational fluid dynamics. This became genesis for the collaboratively developed grid generation system. It is being used by major aerospace organizations in India.

Publications

- [1] "Generating Multimodal Human Dynamics with a Transformation based Representation"; Xinchun Yan, Akash Rastogi, Ruben Villegas, Eli Shechtman, Kalyan Sunkavalli, Sunil Hadap, Ersin Yumer, Honglak Lee; ECCV 2018
- [2] "Deep Image-based Relighting using Optimal Sparse Samples"; Zexiang Xu, Kalyan Sunkavalli, Sunil Hadap, Ravi Ramamoorthi; **SIGGRAPH 2018**
- [3] "Illuminant Spectra-based Source Separation Using Flash Photography"; Zhuo Hui, Kalyan Sunkavalli, Sunil Hadap, Aswin C. Sankaranarayanan; CVPR 2018 (**oral presentation**)
- [4] "A Perceptual Measure for Deep Single Image Camera Calibration"; Yannick Hold-Geoffroy, Kalyan Sunkavalli, Jonathan Eisenmann, Matthew Fisher, Emiliano Gambaretto, Sunil Hadap, Jean-François Lalonde; CVPR 2018
- [5] "Reflectance Capture using Univariate Sampling of BRDFs"; Zhuo Hui, Kalyan Sunkavalli, Joon-Young Lee, Sunil Hadap, Jian Wang, Aswin C. Sankaranarayanan; ICCV 2017
- [6] "Portrait Lighting Transfer using a Mass Transport Approach"; Zhixin Shu, Sunil Hadap, Eli Shechtman, Kalyan Sunkavalli, Sylvain Paris, Dimitris Samaras; TOG 2017 (**SIGGRAPH 2017 presentation**)
- [7] "Neural Face Editing with Intrinsic Image Disentangling"; Zhixin Shu, Ersin Yumer, Sunil Hadap, Kalyan Sunkavalli, Eli Shechtman, Dimitris Samaras; CVPR 2017 (**oral presentation**)
- [8] "Deep Outdoor Illumination Estimation"; Yannick Hold-Geoffroy, Kalyan Sunkavalli, Sunil Hadap, Emiliano Gambaretto, Jean-François Lalonde; CVPR 2017 (**oral presentation**)
- [9] "Shape Estimation from Shading, Defocus, and Correspondence Using Light-Field Angular Coherence"; Michael Tao, Pratul Srinivasan, Sunil Hadap, Szymon Rusinkiewicz, Jitendra Malik, Ravi Ramamoorthi; PAMI, 39 (3), 546-560, 2017
- [10] "EyeOpener: Editing Eyes in the Wild"; Zhixin Shu, Eli Shechtman, Dimitris Samaras, Sunil Hadap; TOG 36(1), 2016 (**SIGGRAPH 2016 presentation**)

- [11] "Shading-Aware Multi-view Stereo"; Fabian Langguth, Kalyan Sunkavalli, Sunil Hadap, Michael Goesele; ECCV 2016
- [12] "Real-Time Oil Painting on Mobile Hardware"; Tuur Stuyck, Fang Da, Sunil Hadap, Philip Dutré; Computer Graphics Forum 2016
- [13] "White balance under mixed illumination using flash photography"; Zhuo Hui, Aswin Sankaranarayanan, Kalyan Sunkavalli, Sunil Hadap; Computational Photography (ICCP), 2016
- [14] "Real-Time Oil Painting on Mobile Hardware"; Tuur Stuyck, Fang Da, Sunil Hadap, Philip Dutre; Compute Graphics Forum, 2016
- [15] "High-quality hair modeling from a single portrait photo"; Menglei Chai, Linjie Luo, Kalyan Sunkavalli, Nathan Carr, Sunil Hadap, Kun Zhou; **SIGGRAPH 2015**
- [16] "Automatic scene inference for 3d object compositing"; Kevin Karsch, Kalyan Sunkavalli, Sunil Hadap, Nathan Carr, Hailin Jin, Rafael Fonte, Michael Sittig, David Forsyth; **SIGGRAPH 2014**
- [17] "Depth from Combining Defocus and Correspondence Using Light-Field Cameras"; Michael W. Tao, Sunil Hadap, Jitendra Malik, and Ravi Ramamoorthi; In Proceedings of International Conference on Computer Vision, **ICCV 2013**
- [18] "Specular Reflection Separation using Dark Channel Priors"; Kim, H., Jin, H., Hadap, S., and Kweon, I.; **CVPR 2013**
- [19] "Multiple light source estimation in a single image"; Jorge Lopez-Moreno, Elena Garces, Sunil Hadap, Erik Reinhard, Diego Gutierrez; Computer Graphics Forum 32(8), 2013
- [20] "Reconstructing shape from dictionaries of shading primitives"; Alexandros Panagopoulos, Sunil Hadap, Dimitris Samaras; Asian Conference on Computer Vision, 2012
- [21] "Non-photorealistic, Depth-based Image Editing"; Jorge Lopez-Moreno, Jorge Jimenez, Sunil Hadap, Ken Anjyo, Erik Reinhard, Diego Gutierrez; Computer and Graphics, Volume 35, Issue 1, February, 2011
- [22] "Industrial-Strength Painting with a Virtual Bristle Brush"; Stephen DiVerdi, Aravind Krishnaswamy, Sunil Hadap; VRST 2010
- [23] "Bristle Tip and Mixer Brush"; Sunil Hadap, Steve DiVerdi, Aravind Krishnaswamy; Poster, NPAR 2010
- [24] "Compositing Images through Light Source Detection"; Jorge Lopez-Moreno, Sunil Hadap, Erik Reinhard, Diego Gutierrez; Computers and Graphics, Volume 34, Issue 6, December, 2010
- [25] "Stylized Depiction of Images Based on Depth Perception"; Jorge Lopez-Moreno, Jorge Jimenez, Sunil Hadap, Erik Reinhard, Ken Anjyo and Diego Gutierrez; Non-photorealistic Animation and Rendering (NPAR), 2010 (**Best Paper Award**)
- [26] "Regularized Depth from Defocus"; Vinay P. Namboodiri, Subhasis Chaudhuri, Sunil Hadap; ICIP 2008.
- [27] "Oriented Strands - dynamics of stiff multi-body system"; Sunil Hadap; ACM SIGGRAPH / Eurographics Symposium on Computer Animation, 2006
- [28] "Rendering Photo-realistic Hair using Graphics Hardware"; Sunil Hadap, Nadia Magnenat-Thalmann; Technical Report, 2003
- [29] "Modeling Dynamic Hair as a Continuum"; Sunil Hadap, Nadia Magnenat-Thalmann; Computer Graphics Forum, Volume 20, Issue 3, Eurographics 2001 Proceedings, Manchester, United Kingdom, September 2001
- [30] "Interactive Hair Styler based on Fluid Flow"; Sunil Hadap and Nadia Magnenat-Thalmann; Eurographics Workshop on Computer Animation and Simulation'2000, Interlaken 2000
- [31] "State of the Art in Hair Simulation"; Nadia Magnenat-Thalmann, Sunil Hadap, Prem Kalra; International Workshop on Human Modeling and Animation, Seoul, Korea, June 28--29, 2000
- [32] "Animating Wrinkles on Clothes"; Sunil Hadap, Endre Bangarter and Pascal Volino and Nadia Magnenat-Thalmann; IEEE Visualization '99, San Francisco 1999
- [33] "MultiBlock Grid Generation for Structured Grids"; Shrijeet Mukherjee, Manoj Apte, Amitay Isaacs, Sunil Hadap and Dr G R Shevare; 5th International Conference on Numerical Grid Generation for Computational Fluid Simulation, April, 1996

Courses / Presentations / Highlights

- [1] Watercolor Simulation in Adobe Sketch, Apple's iPad Pro Launch Event, 2015
- [2] "Advent of RGBD Images: Image Editing, Relighting & Compositing", Plenary Session, Mathematical Progress in Expressive Image Synthesis, Fukuoka, Japan, 2014
- [3] Organizer – "Strands and Hair: Modeling, Animation, and Rendering", course 33, SIGGRAPH 2007
- [4] Organizer – "Introduction to Articulated Rigid Body Dynamics", course 2, SIGGRAPH 2005
- [5] Organizer – "Collision Detection and Proximity Queries", course 14, SIGGRAPH 2004
- [6] Presenter – "Photorealistic Hair Modeling, Animation, and Rendering", course 9, SIGGRAPH 2004
- [7] Presenter – "Photorealistic Hair Modeling, Animation, and Rendering", course 34, SIGGRAPH 2003

Thesis

- [1] Sunil Hadap, "Hair Simulation", PhD Dissertation, 2003
- [2] Sunil Hadap, "Design of Robotics Teaching Aid", Master of Design Thesis, 1995
- [3] Sunil Hadap, "Design of Weather Data Collection Platform", Master of Design Thesis, 1995
- [4] Sunil Hadap, "Multi-block Grid Generation Toolkit", Bachelor of Technology Thesis, 1993

Patents

25 patents granted, 25+ patents in the pipeline

Credits

- Shrek2, PDI/DreamWorks, 2004
- Madagascar, PDI/DreamWorks, 2005
- Over the Hedge, DreamWorks Animation, 2006
- Shrek The Third, PDI/DreamWorks, 2007
- Bee Movie, DreamWorks Animation, 2007
- Adobe Photoshop (multiple)
- Adobe Illustrator (multiple)
- Adobe Photoshop Express, Adobe Photoshop Elements (multiple)
- Adobe Dimension 2017

Rewards / Honors / Achievements

- Distinguished Inventor, Adobe 2011
- Served on PhD Jury – Jorge Lopez-Morano, University of Zaragoza, Spain, 2011
- Technical Achievement Award, DreamWorks Animation, 2005
- Jury's Mention – PhD Dissertation, 2003

Hobbies / Tinkering

Developing high-performance CNC machine tools – milling/routing for rapid prototyping, desktop dental mill

Developing 3D printing solutions for niche industry

In the past, Fine Art Landscape Photography