

## **RESEARCH INTEREST**

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I am a research scientist at Tableau Software. My area of interest is in computer graphics and natural language processing. In particular, the goal of my research is to develop new computer algorithms and user interfaces that enhance visual communication. My research combines concepts and methods from visual art, perceptual psychology, information processing, and cognitive science to help users effectively interact with devices and information in their environment. In addition, I have strong technical experience in identifying interesting and relevant problems in mobile computing, particularly imagery rendered at small scale. A significant portion of my work covers investigation, prototyping and evaluation through quantitative and qualitative methods.

## **EDUCATION**

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Doctor of Philosophy, June 2005.

NORTHWESTERN UNIVERSITY, EVANSTON, IL Advisor: Professor Bruce Gooch

Dissertation Title: Optimizing Computer Imagery for More Effective Visual Communication

Master of Science Computer Science, June 2004.

NORTHWESTERN UNIVERSITY, EVANSTON, IL.

Bachelor of Science in Computer Engineering, with honors, December 2000.

BANGALORE INSTITUTE OF TECHNOLOGY, BANGALORE, INDIA.

Honors Thesis Title: Behavior Protocols in Internet Auctions

Honors Thesis Advisor: Professor Yadati Narahari

Department of Computer Science and Automation,

INDIAN INSTITUTE OF SCIENCE, BANGALORE, INDIA.

## **RESEARCH EXPERIENCE**

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Research Scientist, 2012 - present.

TABLEAU SOFTWARE, MENLO PARK CA.

My research largely involves new methodologies to help people better understand and visualize data. This encompasses data analysis, natural language processing, and visualization concepts.

Co-founder, 2012 - present.

ADOLIO.

Adolio is a technology that utilizes patented revolutionary algorithms to minimize the number of clicks for accessing product information by compositing individual pieces of relevant data from the consumers preferred online data sources into a single information collage on a mobile device. I've been primarily responsible for developing the Android app and the backend algorithms for curating web content.

Principal Researcher Scientist, 2006 - 2012.

NOKIA RESEARCH CENTER, PALO ALTO, CA.

My work involves researching novel rendering algorithms particularly targeted for mobile based interactive visualizations. My research interests include semantic graphics , *i.e.* the usage of machine learning to better improve graphics design, such as for maps, automotive interfaces, sensor based technologies, and cross device interactions.

In particular, my research covers the following three areas:

**Cross device interaction, sensors and new interface paradigms:**

The number of devices a user owns and interacts with is steadily increasing. Mobile phones, tablets, and laptops are now common in a user's ecosystem and introduce opportunities to engage in tasks that span multiple devices. I am interested in new interaction and interface paradigms that allow a user to seamlessly interact with devices around him. I have worked extensively with new form factors on touch screen devices and associated hardware, along with gestural interaction to better understand how cross device behavior can be more effective and intuitive. I leveraged on-device accelerometers and touch-screen specific sensors such as touch and pressure to determine meaningful interactions and content presentation on these devices.

**Map navigation and automotive interfaces:**

One of the major problems with visualizing route maps is that the amount of information visualized is always the same regardless of the fact that an individual may be more familiar with the region or whether an individual is driving at varying speeds. Studies have shown that complex visualizations with visual clutter can cause cognitive overload which adversely affects the performance of a user. My research involves the use of mobile and automotive context to automatically vary map visualization being displayed to the user based on the speed of the vehicle as well as the familiarity of the region that the user is driving in.

**Visualization and iconography:**

Image retargeting is the process of optimizing imagery for different display resolutions. The main challenge is deciding what is needed for the target audience and the retargeting work can be applied to determine optimal approaches in the creation and layout of mobile content. My work, such as 'Semanticons,' can not only be applied for display critical purposes, but also to general, commonly used applications that can help the user to quickly locate information or make a given task more efficient. Further, I am also interested in developing new visualizations and navigation techniques for large scale data on a mobile device.

Research Scientist, 2005 - 2006.  
NOKIA RESEARCH CENTER, DALLAS, TX.

Worked on technologies of rich media services, i.e. the ability to integrate advances made in the mobile space domain, delivering music, speech, text, raster graphics, scalable vector graphics (SVG) and video. This involves the ability to deliver these modalities, to interact with these modalities, and to do it in a way that allows for the construction, delivery and use of compelling mobile services in an effective and economic manner. This includes contribution to standards (3GPP, OMA, W3C) and developing features to extend SVG to support rich media functionality on Symbian S60 platforms. Several patents were filed and a publication submitted to an IEEE conference. Applications include interactive maps, mobile TV and mobile entertainment.

Involved in the Future UI Program to provide advanced graphics effects, hardware acceleration and optimization to 2D and 3D UI components on S60, S40 and Linux platforms. Exploring a new genre of OpenGL ES 2.0 shader effects for mobile UI. Working with Nokia UI Design team to explore usability concepts and mapping graphics technology to such concepts.

Graduate Research Assistant, 2001 - 2005.  
NORTHWESTERN UNIVERSITY, EVANSTON, IL.

**Automatic Image Retargeting**, to provide *effective* small images by preserving the recognizability of important image features during downsizing.

**Semantics**, an information visualization method for automatically generating semantically enhanced file icons in desktop applications.

**Vector-Based Animation Retargeting**, to enable *Flash* animations created for the World Wide Web to accommodate the aspect ratios of handheld display devices.

**Mona Lisa Smile**, a software system that allows non-artists to easily create novel and interesting portraits that depict conflicting emotional states at varying spatial frequencies. This work is based on psychologists' theories on the secret behind Mona Lisa's enigmatic smile.

## TECHNICAL SKILLS

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As part of my research, I have experience programming with Python, Natural Language Toolkit (NLTK), Javascript/D3, Java, C#, and Flash/Actionscript 3.0. Platforms: Windows 8, Windows 7 Phone and Android.

In order to evaluate my work and other systems, I employ one of many methods such as diary studies, questionnaire design, individual and group interviews, in-lab and field observations as all as statistical analysis.

## PUBLICATIONS

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### REFEREED JOURNAL AND CONFERENCE PUBLICATIONS

Talbot, J., Setlur, V., Anand, A. Four Experiments on the Perception of Bar Charts. *InfoVis* 2014.

Setlur, V., Mackinlay, J. Automatic Generation of Semantic Icon Encodings for Visualizations. *CHI* 2014.

Setlur, V., Wiehr, F., Joshi, A. DriveSense: Contextual Handling of Large-scale Route Map Data for the Automobile. *IEEE BigDataVis* 2013.

Amini, S., Setlur, V., Hayashi, E., Hong, J. Investigating Collaborative Mobile Search Behaviors. *Mobile HCI* 2013.

Weihr, F., Setlur, V., Joshi, A. Auto(mobile): Mobile Visual Interfaces for the Road. *Siggraph Mobile* 2012.

Sohn, T., Li, F., Battestini, A., Setlur, V., Mori, K., Horii, H. Myngle: Unifying and Filtering Web Content for Unplanned Access Between Multiple Personal Devices. *Ubicomp 2011: ACM International Conference on Ubiquitous Computing*.

Bales, E., Sohn, T., Setlur, V. Planning, Apps, and the High-end Smartphone: Exploring the landscape of modern cross-device reaccess. *Pervasive 2011: International Conference on Pervasive Computing*

Setlur, V., Rossoff, S., Gooch, B. Wish I Hadnt Clicked That: Context Based Icons for Mobile Web Navigation and Directed Search Tasks. *Intelligent User Interfaces (IUI)* 2011.

Sohn, T., Setlur, V., Mori, K., Kaye, J., Horii, H., Battestini, A. Ballagas, R., Paretto, C., Spasojevic, M. Addressing Mobile Information Overload in the Universal Inbox through Lenses. *Mobile Human Computer Interaction (MobileHCI)* 2010.

Battestini, A., Setlur, V., Sohn, T. A Large Scale Study of Text Messaging Use. *Mobile Human Computer Interaction (MobileHCI)* 2010.

Setlur, V., Kao, C., Mikelsons, P. Towards Designing Better Map Interfaces for the Mobile: Experiences from Example. *The 1st International Conference on Computing for Geospatial Research and Application*.

Tian, F., Lv, F., Wang, J., Wang, H., Luo, W., Kam, M., Setlur, V., Dai, G., Canny, J. Lets Play Chinese Characters Mobile Learning Approaches via Culturally Inspired Group Games, *CHI* 2010.

Setlur, V., Battestini, A., Sohn, T., Horii, H. Using Gestures on Mobile Phones to Create SMS Comics, *International Conference on Tangible, Embedded and Embodied Interaction (TEI)*, 2010.

Chen, W., Battestini, A., Gelfand, N., Setlur, V. Visual Summaries of Popular Landmarks from Community Photo Collections , *ACM Multimedia* 2009.

Setlur, V., Battestini, A. Using Comics as a Visual Metaphor for Enriching SMS Messages with Contextual and Social Media, *MobileHCI* 2009, *Workshop on Sharing Experiences with Social Mobile Media*.

- Setlur, V., Battestini, A., and Ding, Xianghua. Automatic Generation of Travel Scrapbooks, IEEE International Conference on Multimedia and Expo (ICME), 2009.
- Setlur, V., Rossoff, S., Gooch, B. SemantiLynx: Using Context Based Icons for Web Navigation and Directed Search Tasks, UIST 2008.
- Tian, F., Setlur, V., Tilt Menu: Using the 3D Orientation Information of Pen Devices to Extend the Selection Capability of Pen-based User Interfaces, CHI 2008.
- Setlur, V., Neinhaus, M., Lechner, T., Gooch, B. Retargeting Images for Preserving Information Saliency, IEEE Computer Graphics and Applications (CG&A) 2007.
- Tian, F., Ao, X., Wang, H., Setlur, V., Dai, G. The Tilt Cursor: Enhancing Stimulus-Response Compatibility by Providing 3D Orientation Cue of Pen, CHI 2007.
- Capin, T., Haro, A., Setlur, V., and Wilkinson, S., Camera-Based Virtual Environment Interaction on Mobile Devices, 21st International Symposium on Computer and Information Sciences (ISCIS), 2006.
- Setlur, V., Optimizing Computer Imagery for More Effective Communication. ACM Grace Hopper Conference for Women in Computing, 2006.
- Setlur, V., Capin, T., Chitturi, S., Vedantham, R., and Ingrassia, M., MORE: Mobile Open Rich-media Environment, IEEE International Conference on Multimedia and Expo (ICME), 2006.
- Setlur, V., Wilkinson, S. Automatic Stained Glass Rendering. Computer Graphics International (CGI) 2006.
- Setlur, V., Takagi, S., Raskar, Ramesh., Gleicher, M., and Gooch, B. Automatic Image Retargeting. In the Mobile and Ubiquitous Multimedia (MUM) 2005, ACM Press 2005.
- Setlur, V., Xu, Yingqing, and Gooch, B. Vector Based Retargeting. In the Mobile and Ubiquitous Multimedia (MUM) 2005, ACM Press 2005.
- Haro, A., Mori, K., Setlur, V., and Capin, T. Mobile Camera-based Adaptive Viewing. In the Mobile and Ubiquitous Multimedia (MUM) 2005, ACM Press 2005.
- Setlur, V., Albrecht-Buehler, C., Gooch, A., Rossoff, S., Gooch, B. Semanticons: Semantic-Based File Icons. In IEEE Computer Graphics and Applications Special Issue on Smart Depiction 2004, IEEE Press, 2004.
- Setlur, V., and Gooch, B. Is That a Smile? Gaze Dependent Facial Expressions. In Proceedings of the 3rd International Symposium on Non-photorealistic Animation and Rendering 2004, pp. 79 - 86, ACM Press, 2004.
- Setlur, V., Shamma, D., and Hammond, K. Towards a Non-Linear Narrative Construction. In Proceedings of the 8th International Conference on Intelligent User Interfaces 2003, pp. 82-86, ACM Press, 2003.

#### TECHNICAL REPORTS AND CONFERENCE PRESENTATIONS

- Setlur, V., Albrecht-Buehler, C., Gooch, A., Rossoff, S., Gooch, B. Semanticons: Semantic-Based File Icons. Northwestern University Technical Report. NWU-CS-04-46, 2004.

Setlur, V., Takagi, S., Raskar, R., Gleicher, M., and Gooch, B. Automatic Image Retargeting. Conference Abstracts and Applications of ACM SIGGRAPH 2004.

Setlur, V., Takagi, S., Gleicher, M., Raskar, R., and Gooch, B. Automatic Image Retargeting. Northwestern University Technical Report. NWU-CS-04-41, 2004.

## **PATENTS**

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Filed 102 patents with 14 patents granted in various countries so far.

### **PATENTS GRANTED**

System and method for measuring SVG document similarity. Grant number 7403951, 22 July 2008, USA. Also granted in Hong Kong, China, Europe, Japan, Republic of South Korea and Taiwan.

Retargeting images for small displays. US Pat. 7574069, Aug 2009.

Method to Embedding SVG content into an ISO Base Media File Format for progressive downloading and streaming of rich media content. Grant number 0927928, 16 Nov 2009, South Korea. Also filed in Taiwan, USA, Europe and China.

Assembling rich media based random access points with forward error correction frames. Grant number 7746882, 29 Jun 2010, USA. Also granted in South Africa and South Korea. Filed in Indonesia, Mexico, Nigeria, Ukraine, Australia, Brazil, Canada, China, Europe and India.

System and method for providing feedback and forward transmission for remote interaction in rich media applications. Grant number 0984694, 27 Sept 2010, South Korea. Also filed in USA, Taiwan, Japan, Europe and China.

Extensions to rich media container format for use by mobile broadcast/multicast streaming servers. Grant number 7917644, 29 Mar 2011, USA. Also granted in South Korea. Filed in India, Europe and China.

Apparatus, method and computer program product for generating a thumbnail representation of a video sequence. US Pat. 8032840 B2, Oct 2011.

Transport mechanisms for dynamic rich media scenes. US Pat. 8239558 B2, Aug 2012.

Method and apparatus for indicating an analysis criteria. US Pat. 8406458 B2, Mar 2013.

Directional peer-to-peer networking. US Pat. 8620348 B2, Dec 2013.

Method, apparatus and computer program product for visually grouping relationships from databases. US Pat. 8725744 B2, May 2014.

### **PATENTS PENDING**

Transport mechanisms for dynamic rich media scenes. Publication number WO2007/000649, filed Jun 2006, USA, India, Europe and China.

Apparatus, method and computer program product for generating a thumbnail representation of a video sequence. Publication number 20070162873,

led Jan 2006, USA.

System and method for providing quality feedback metrics for data transmission in rich media services. Publication number WO2007/060521, filed Nov 2006, USA, Europe, South Korea, China and Japan.

System and method of XML based content fragmentation for rich media streaming. Publication number 20080040498, filed Aug 2006, USA, China, Europe and India.

Method and system for dynamically generating perceptually adaptive graphical user interface. Publication number 20080079750, filed Sep 2006, USA.

System and method for screen orientation in a rich media environment. Publication number 20080209442, filed Jan 2008, USA.

System and Mechanisms for Handling Relevancy and Ambiguity in Mobile Visual Search. Publication number 20080270378, filed Jun 2007, USA, Europe, South Korea, China and India.

Mechanisms for Identifying Serendipitous Information Correlations from Heterogeneous Social Communities Through Visually Rich Mashups. Publication number 20090299990, filed May 2008, USA.

System and Mechanisms for Using Sensors for Enhanced Digital Expression in SMS Comics. Publication number 20100248741, filed Mar 2009, USA, China and Europe.

Method, apparatus, and computer program product for vector video retargeting. Publication number 20100259683, filed Apr 2009, USA, China, Europe and India.

Visual Affordances for Gracefully Handling Identity Resolution in User Interfaces. Publication number 20110125770, filed Nov 2009, USA and Europe.

System and Mechanisms for Customizable Map Retargeting based on Non-Tile Based Rendering and Semantic Zoom. Publication number 20110063301, filed Sep 2009, USA.

System and Mechanisms for Visually Summarizing the Activity of Information Filters on a Mobile Device. Publication number WO2011/117835, filed Mar 2010, USA.

System and Mechanisms for Monitoring Information Streams and Generating Events. Publication number WO2011/117833, filed Mar 2010, USA.

System and Mechanisms for Logging of Information Stream Events in Activity Graphs. Publication number WO2011/117834, filed Mar 2010, USA.

System and Mechanisms for Generating Map Snippets of Web Based Map Searches. Publication number WO2011/151507, filed Jun 2010, USA.

Apparatus and method for providing for interaction with content within a digital bezel. Publication number US20140055367, filed Aug 2012, USA.

Directional peer-to-peer networking. Publication number US20130190005 A1, filed Jan 2013, USA.

Apparatus and method for providing a digital bezel. Publication number WO2013153266 A1, filed Mar 2013.

Method and apparatus for associating context information with content. Publication number WO2014001616 A1, filed Jun 2013.

Apparatus and method for selection of a device for content sharing operations. Publication number WO2014001614 A1, filed Jun 2013.

## **COLLABORATION**

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I firmly believe that in order to do effective research, the whole is greater than the sum of its parts. At work, I enjoy working with multidisciplinary teams and people ranging from designers, engineers, ethnographers, professors, interns, and cognitive scientists. Externally, I actively collaborate with academia in the form of projects, teaching, and being part of students' thesis committees. Here is a list of external collaborators I have worked with:

Professor Kwan-Liu Ma, UC Davis.

Professor Benjamin Watson, North Carolina State University.

Professor Alark Joshi, Boise State University.

Professor Pat Hanrahan, Stanford University.

Professor John Canny, UC Berkeley.

## **TEACHING AND MENTORING**

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I am interested in teaching interdisciplinary graduate level courses in information visualization, computer graphics, computational aesthetics, art and perception. At the undergraduate level I am interested in teaching algorithms, data structures, introductory programming courses, web technologies, human computer interaction, and graphics.

I have co-taught courses on mobile interfaces and graphics at various conferences including Siggraph Asia, Mobile HCI and HCI International.

Other appointments include:

Adjunct Professor, Carnegie Mellon University, 2007

Taught a mobile course on developing mobile thick clients using J2ME.

Lecturer, San Jose State University, 2007

Taught Mobile Multimedia Technologies, an undergraduate and graduate course on mobile 2d and 3D Java based graphics APIs, web technologies and Flash Lite.

Industry Mentor, Stanford University

Fall 2006 - Spring 2007, advising 4 students on a specific joint project between Nokia Research Center, Nokia Design and Stanford Design Schools ME 310 course. Mentoring involves feedback, suggestions and advice on presentations and prototypes developed by this student group.



**Teaching Assistant, Northwestern University**

CS 395/495-25: Non-photorealistic Rendering (with Bruce Gooch), Department of Computer Science, Northwestern University, Winter 2004. Developed class web page, led discussion, and performed evaluation.

CS 330: Human-Computer Interaction (with Ben Watson and Louis Gomez), Department of Computer Science, Northwestern University, Winter 2002. Led discussion, grading and example solutions, office hours.

CS 130: Tools and technology of the World-Wide Web (with Kristian Hammond and Sanjay Sood), Department of Computer Science, Northwestern University, Fall 2002. Grading

CS 336: Design and Analysis of Algorithms, Department of Computer Science, Northwestern University, Spring 2001. Grading.

**Teaching Mentor, Northwestern University**

Mentored new graduate students on teaching engineering courses at the Searle Center for Teaching Excellence, Northwestern University in Summer 2002 under the guidance of Melissa Luna. Prepared teaching material, and course notes, and advised students on teaching techniques and grading.

**INVITED TALKS**

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Semantic Graphics for More Effective Visual Communication, keynote at Graphics Interface 2009.

Diversity in your Workplace, March 2009, CRA-W Graduate Cohort Workshop.

Non-Academic Career Path Post Ph.D., March 2009, CRA-W Graduate Cohort Workshop.

Semantilinks: Context Aware Hyperlinks for More effective Browsing, April 2006, Nokia Exchange for Research and Development (NERD) 2006, Helsinki, Finland.

Time Management and Balance: A Graduate School Gathering, October 8 2004, Grace Hopper Conference, Chicago, IL.

Vector-Based Animation Retargeting, November 6 2004, the Mid-Graph Conference, Northwestern University, Evanston, IL.

Is that a Smile? Gaze Dependent Facial Expressions, November 10 2003, the Mid-Graph Conference, Washington University, St. Louis, MO.

A Life Without Friction: Tales from the InfoLab, January 2003, the International Conference of Intelligent User Interfaces, Miami, FL.

## **PRESENTATIONS AND SYSTEM DEMONSTRATIONS**

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Nokia Mashups. Demo and poster at HotMobile 2009.

Intelligent Visual Matching for Providing Context-Aware Information to Mobile Users. Supplemental proceedings of the Ubicomp 2007.

Image Retargeting and Semanticons. At the first annual Computer Science Department Open House (with Bruce Gooch), September 2004.

Image Retargeting and Semanticons. McCormick External Advisory Committee (with Bruce Gooch), September 2004.

Imagination Environment. At the 8th International Conference on Intelligent User Interfaces (with Ayman Shamma), January 2003.

## **INTERNSHIP**

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Spring 2004, worked on a video processing project at Mitsubishi Electric Research Labs (MERL), Cambridge, MA with Dr. Ramesh Raskar.

Project Description:

Involved in a project to interactively edit video as a 3D volume in the space-time domain. This allows users to perform video fast-forwarding by indicating volumetric areas in 3D space that can be skipped or deleted.

## **FELLOWSHIP**

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2002 Teaching Assistant Fellow at the Searle Center for Teaching Excellence, Northwestern University, Evanston, IL.

Designed and conducted teaching assistant workshops.

## **PROFESSIONAL AFFILIATIONS AND SERVICE**

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General chair of the International Conference on Mobile and Ubiquitous Multimedia (MUM) 2006, held at Stanford University.

Reviewer for SIGGRAPH, Eurographics, InfoVis, IEEE CG&A, IEEE Transactions on Multimedia, ACM Multimedia, UIST, CHI, Mobile HCI.

President of the ACM-W (ACM Women in Computing) organization at the Computer Science Department at Northwestern University. 2003 - 2004

Member of ACM and IEEE.

## **REFERENCES**

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Available upon request.