

Sujoy Roy

Contact Information	Researcher Machine Learning Innovation Center Network, SAP Singapore 138632	T : (+65) 6664-6945 M : (+65) 93232838 E -mail: sujoy.roy@sap.com
Nationality	Singaporean	
Research Interests	Machine Learning, Statistical Modeling and Inference, Personalization and Recommender Systems, Computer Vision, Multimedia Understanding and Security (Content ID & Forensics),.	
Education	National University of Singapore , Singapore Ph.D., Computer Science, 2001 - 2005 <ul style="list-style-type: none">• Dissertation Topic: “Watermarking Techniques Using Knowledge of Hosts Database”• Advisor: Dr. Chang Ee-Chien• Internal Committee: Dr. Mohan Kankanhalli (NUS), Dr. Huang Zhiyong (NUS) Indian Institute of Technology , New Delhi, India M.S.(Research), Computer Science, May 1999 - June 2001 <ul style="list-style-type: none">• Dissertation Topic: “Region based registration for image mosaicing”• Advisor: Prof. Sanjiv Kapoor & Prof. K. K. Biswas• Dissertation Committee: Dr. Prem Kalra (IITD), Prof. Amitabha Mukherjee (IITK), Prof. Subhashis Banerjee (IITD) Birla Institute of Technology , Mesra, Ranchi, India B.E., Computer Science, May 1995 - April 1999	
Honors and Awards	Winner of EmotiW 2016: Emotion Recognition Challenge at ACM International Conference on Multimodal Interactions 2016 <i>Distinction Award</i> in Youth Science Conference for project “Intelligent User Interfaces for Recommending User Interface Components”, Singapore, 2014. Second Runner-Up: LIVE News Recommendation Benchmarking Competition, NRS@RecSys 2013 (amongst 34 algorithms) <i>Commendation for Excellence in Mentorship</i> in 2013-14, from A*STAR Graduate Academy Dean’s Graduate Award, 2005-2006 Dean’s Graduate Award, 2003-2004 Singapore Millennium Foundation (SMF) Scholarship, 2003-2006 National University of Singapore Graduate Fellowship, 2001-2003 Indian Institute of Technology: Hughes Software Systems Graduate Fellowship, 1999-2001 (2 awards out of all graduate students in CSE, IIT Delhi) Birla Institute of Technology: BIT Undergraduate Merit Scholarship, 1995-1999	
Professional Experience	ML Researcher , Innovation Center Network, SAP	Feb, 2016 - Present

Founding member of SAP Leonardo ML Foundation Team (R&D in Machine Learning)
Designed and developed end-to-end production ready functional services on SAP Leonardo ML Foundation (Language Detection, Face API, Fashion API, Object Detection Re-trainable Service, Sentiment Analysis, Meter Reading)
Lead Researcher/Engineer driving Computer Vision related topics within ML Foundation team
Deep Learning Evangelist and educator for openSAP

Research Scientist, Institute for Infocomm Research, Singapore

Feb, 2006 - Feb 2016

Project: Enhancing Personalized Recommendation through better understanding of Content

Project Type: Industry Funded (Comcast & NBC Universal)

Role: Lead Researcher

Duration: Dec 2013- June 2015

Description: Designed a item-item based collaborative filtering approach that achieves a trade-off between performance and memory utilization. Compared to state of the art in personalized item recommendation, the proposed method preserves recall performance under 97% reduction in memory utilization. The algorithm was implemented in Python under a Hadoop framework to facilitate dealing with the large data set. The data set consists of Video On Demand usage history of 23 million users in the US. A patent on this work was filed in the US and Singapore.

Project: Theory and Algorithms for Statistical Content Identification

Project Type: Academic, Funded by National Science Foundation (NSF)

Role: Collaborating Scientist (PI: Prof. Pierre Moulin, UIUC)

Duration: 1 Aug 2012 - 31 July 2015

Description: The goal of this project was to develop an analytical framework for content identification based on fundamental principles and modern methods of statistical inference and information theory and to develop novel content identification algorithms. The project focuses on the following four research topics: 1. Hash-Based Inference. 2. Information-Theoretic Analysis: Content identification is formulated as a communication problem with storage constraints and its fundamental performance limits are investigated. 3. Code Design: A learning-theoretic approach is developed for statistical modeling of content fingerprints and degradation channels from training data, and for designing hashing codes and decoding metrics that are optimally matched to these statistics. 4. Applications: to audio, images, and video are explored, as well as forensic analysis and security.

Project Title: Personalized Recommendation of TV Programs

Project Type: Industry (NBC Universal)

Role: Project Manager

Duration: Jan 2011 - Apr 2012

Remark: Designed and developed a framework for personalized content recommendation that has the following novel features. (1) Ability to generate structured metadata for TV shows from unstructured / scanty metadata facilitating better understanding of the content. (2) A method for extracting semantic user interest features based on analyzing users watching behavior (channel surfer, dedicated to a channel etc) and usage actions (like pressing of MUTE, VOLUME UP / DOWN, explicit channel number pressing, selecting of shows through EPG etc.) (3) An algorithm for rating unrated content from usage logs using semantic user interest features. (4) A method for automatically recommending shows related to external events (contrast with social watching behavior based recommendations which are post-facto). (5) A method for scheduling content from multiple sources (VOD & scheduled TV content) onto a time line for watching on TV. A web portal and iOS application were developed to demonstrate the framework on StarHUB Electronic Program Guide (EPG) content. A patent on the proposed framework was filed in the US and Singapore.

Project: COtent Driven Interactive Social Tele-experience (CODIST)

Project Type: Academic

Role: Project Lead

Duration: 1 June 2010 - 30 Nov 2012

Funding Agency: Intramural

Remark: This project aims to investigate and develop technologies for (1) Personalized EPG services (Recommendation and Scheduling) and (2) Content driven games (a framework for developing games based on LIVE and recorded content on TV and user generated content). The project led to a research collaboration agreement with NBC Universal on the topic of personalized recommender systems

Project: Sports video analysis

Project Type: Industry (Zeicast Pvt. Ltd)

Role: Project Manager

Duration: Nov 2009 - May 2010

Description: The objective of the project was to develop technologies for detecting important events in sports video footage. A tool for detecting 'bowling' segments inside footage of cricket matches (both day and night games) was developed in C++ using OpenCV. The software tool was licensed to Zeicast.

Project: Personal Video Explorer (PVE)

Project Type: Academic

Role: Principle Investigator

Duration: June 2009 - June 2010

Description: PVE is a genre specific multimedia exploratory search system. PVE's unique table-of-contents based recommendation allows exploration and helps learn, investigate and explore through video archives. PVE also helps mine the long tail of search which is attractive for content creators. The back-end of the PVE system was developed in python. The front end was a web-portal that allows users to explore and view News videos (streaming using an Adobe streaming server).

Project: Secure Media Streaming

Project Type: Academic

Role: Team Member (PI: Qibin Sun)

Duration: 1 August 2006 - 30 July 2009

Funding Agency: Institute for Infocomm Research (EOM) + Science and Engineering Research Council, A*STAR

Description: To develop infrastructure and technologies to achieve secure robust and optimal end-to-end media streaming. Designed and developed robust hashing algorithms for content ID.

Teaching

Course TA: CS356/493 Algorithms Design and Analysis, IIT, Delhi **July - November, 2000**
Undergraduate level course in Algorithms. Duties included conducting tutorials, grading exams and homework assignments.

Course TA: CS474 Computer Graphics, IIT, Delhi **January - May, 2000**
Undergraduate Level Course on Computer Graphics. Duties included conducting tutorials, grading exams and reviewing project assignments and presentations.

Academic Supervision

PhD Students Graduated: ECE-NUS(1), ADSC-UIUC (1) Current: CSE-NTU Singapore (1), SOC-NUS (2)

Undergraduates (FYP) - Completed: SOC-NUS (1), EEE, NTU (1)

Interns - More than 10 from Polytechnics, NTU, NUS

Secondary / JC Mentorship Past: (6)

Development Experience

- Machine Learning Libraries: **Scikit-learn**, **OpenCV**, **dlib**, **NLTK**, **Weka**.

- Deep Learning Libraries: **Tensorflow/Keras**, Caffe
- Data Analytics / Visualization Software: R/ggplot2, **Python (Pandas/Matplotlib/Seaborn)**, Elastic Search /Kibana, Tablue
- Database Technologies: **MongoDB, MySQL, Postgres**, Redis, HANA
- Distributed/Parallel Computing: Hadoop (Hive / Pig), **Spark, CUDA**
- Languages: **Python, C++**, Java, C, MATLAB, Android Development.
- Environments: **Linux, iOS**, WINDOWS, ROS.
- Productive Deployment: **Tensorflow Serving, Flask, Git, Docker, CloudFoundry, Kubernetes**, Jenkins
- 8085, 80x86 Assembly Language programming

Professional Activities

Member of IEEE, ACM

Reviewer for Journals: IEEE Pattern Analysis and Machine Intelligence, IEEE Trans. on Information Forensics and Security, IEEE Trans. on Image Processing, IEEE Trans. on Circuits Systems and Video Technology, IEEE Trans. on Multimedia, IEEE Multimedia, IEEE Trans. on Systems, Man, and Cybernetics, Multimedia Tools and Applications (Springer), Multimedia Systems Journal (Springer), ACM TOMMCAP, Imaging Science Journal

Reviewer for Conferences: CVPR, ICME, ICIP, PCM, ACM Multimedia, ICPR, ICB

Certifications

Machine Learning (Marks: 100%) - *Coursera (Stanford University: Prof. Andrew Ng)*

Introduction to Recommender Systems (Distinction) - *Coursera (University of Minnesota - Prof. Joseph Konstan / Dr. Michael Ekstrand)*

Linear and Integer Programming - *Coursera (University of Colorado, Boulder - Prof. Sriram Shankarnarayanan / Dr. Shalom Ruben)*

Neural Networks for Machine Learning (Distinction) - *Coursera (University of Toronto - Prof. Geoffrey E. Hinton)*

Data Analysis and Statistical Inference (Distinction) - *Coursera (Duke University - Dr. Mine Cetinkaya Rundel)*

Planning and Managing Projects (PMP) - *ESI International*

Foundations of Android Programming - *Developer Learning Solutions*

Big Data and Hadoop Developer - *SimpliLearn*

Patents

METHOD AND SYSTEM FOR COLD START VIDEO RECOMMENDATION, US Patent 15/263,385 (filed)

METHODS AND SYSTEM FOR PERSONALIZED RECOMMENDATION MODELING. US Patent 9473730 (with Micheal Li, Wang Xianjun, Yau Wei Yun and Sheau Ng)

MODELING TV VIEWER FROM USAGE LOGS FOR PERSONALIZED RECOMMENDATION US Patent (disclosure)(I2R/P/07045/00/US) (with Yau Wei Yun)

SYSTEM AND METHOD FOR SELECTING ADAPTIVE SECONDARY CONTENT BASED ON A PROFILE OF PRIMARY CONTENT. US Patent 14469419. (filed) (with Yau Wei Yun, Kong Wah Wan, Khalid. Md, Sheau Ng, Shannon McKenzie, Andrew Hanna and Jeffrey Reale)

RECOMMENDATION SYSTEM USING A TRANSFORMED SIMILARITY MATRIX, US Patent 2014446. (filed) (with Sheau Ng, Wan Kong Wah, Yau Wei Yun, Hassan Sayyadi, Amit Bagga and Oliver Jojic)

Book Chapters

Qiming Li and Sujoy Roy: Secure Robust Hash Functions and Their Applications in Non-Interactive Communications, pages 128-139, in Li, Chang-Tsun, and Anthony T.S. Ho. "Crime Prevention

Technologies and Applications for Advancing Criminal Investigation.” IGI Global, 2012. 1-348.
Web. 20 Jul. 2015. doi:10.4018/978-1-4666-1758-2

Publications

- PERSONALIZATION
RECOMMENDER
SYSTEMS
- Sujoy Roy, Sharat C. Guntuku. Latent Factor Representations for Cold-Start Video Recommendation. Proceedings of the 10th ACM Conference on Recommender Systems, pp 99-106, 2016
- Sharat C Guntuku, Joey T Zhou, Sujoy Roy, Lin Weisi, Ivor W Tsang. Who likes What, and Why? Insights into Personality Modeling based on ImageLikes’. IEEE Transactions on Affective Computing, 2016
- Sharat G., Joey. T. Z, Sujoy Roy, Ivor T. Zhang, W. Lin: Understanding Deep Representations Learned in Modeling User Likes. IEEE Transactions on Image Processing (Volume: 25, Issue 8), pp 3762-3774 2016
- Sharat G., Sujoy Roy, W. Lin, V. Jakhetiya. Personalizing User Interfaces for improving Quality of Experience in VoD Recommender Systems. IEEE QoMEX 2016
- Sharat G., Sujoy Roy, W. Lin, L. Qiu, J. Vinit. Do Others Perceive You As You Want Them To? Modeling Personality based on Selfies. ACM Multimedia 2015 (*Workshop on Affect and Sentiment*)
- Sharat G., Sujoy Roy, W. Lin. Evaluating visual and textual features for predicting user likes, IEEE ICME 2015.
- Sharat G., Sujoy Roy, W. Lin. Personality Modeling based Image Recommendation. International Conference on Multimedia Modeling (MMM) 2015.
- Sharat G., Joey. T. Z, Sujoy Roy, Ivor T. Zhang, W. Lin. Deep Representations for Modeling User ‘Likes’. Asian Conference on Computer Vision (ACCV) 2014 (*Orals: Acceptance Rate: 4%*).
- Ilija Ilievski and Sujoy Roy. Personalized News Recommendation based on Implicit Feedback. News Recommendation Workshop, ACM RecSys 2013. (*Received 3rd position in LIVE News Recommendation Challenge*).
- Ruchir Srivastava, Jiashi Feng, Sujoy Roy, Shuicheng Yan and Terence Sim. Don’t ask me what i’m like, just watch and listen. ACM Multimedia 2012: 329-338 (*Orals: Acceptance Rate: 5%*)
- Ruchir Srivastava, Sujoy Roy, Tan Dat Nguyen and Shuicheng Yan. Automatic User Preference Elicitation for Music Recommendation. Pacific Conference on Multimedia (PCM) 2012: 605-615
- AFFECTIVE
ANALYTICS
- Jianshu Li, Sujoy Roy, Jiashi Feng, Terence Sim. Happiness level prediction with sequential inputs via multiple regressions. pp. 487-493, Proceedings of the 18th ACM International Conference on Multimodal Interaction 2016. (**Winner of EmotiW 2016 Challenge**)
- Ruchir Srivastava, Sujoy Roy: Utilizing 3D flow of points for facial expression recognition. Multimedia Tools and Applications. 71(3): 1953-1974, 2014.
- Ruchir Srivastava, Shuicheng Yan, Terence Sim and Sujoy Roy: Recognizing emotions of characters in movies. ICASSP 2012: 993-996 (*Orals*)
- Ruchir Srivastava, Sujoy Roy, Shuicheng Yan and Terence Sim. Accumulated motion images for facial expression recognition in videos. Face and Gesture (FG) 2011: 903-908

Ruchir Srivastava, Sujoy Roy, Shuicheng Yan and Terence Sim. Multi-actor Emotion Recognition in Movies Using a Bimodal Approach. International Conference on Multimedia Modeling (MMM) (2) 2011: 465-475

Ruchir Srivastava, Sujoy Roy and Terence Sim: Rotation invariant Facial Expression Recognition in image sequences. IEEE International Conference on Multimedia and Expo (ICME) 2010: 179-184

R. Srivastava and Sujoy Roy. Facial Expression Recognition using Residues. To appear in proceedings of IEEE TENCON 2009.

INFORMATION
HIDING

Sujoy Roy, Ee-Chien Chang and K. Natarajan. A unified framework for resolving ambiguity in copy detection. ACM Multimedia Conference, pp. 648-655, Singapore, 2005. (*Orals: Acceptance Rate: 49/312*)

Sujoy Roy, Qiming Li and Ee-Chien Chang. Content-based Image Authentication of Point-set Features using helper data. *Technical Report*, SOC, NUS, 2005.

Sujoy Roy and Ee-Chien Chang. Watermarking with Retrieval Systems, ACM Multimedia Systems, volume 9, number 5, pp 433-440, March 2004.

Sujoy Roy and Ee-Chien Chang. Watermarking Color Histogram, IEEE International Conference on Image Processing, Vol. 4, pp. 2191-2194, Singapore, 2004.

Sujoy Roy. Issues in Proof of Ownership of Relational Data. *Technical Report*, SOC, NUS, 2004.

Sujoy Roy and Ee-Chien Chang. Watermarking with knowledge of images database, IEEE International Conference on Image Processing, Vol. 2, pp.471-474, Barcelona, Spain, 2003. (*Orals*)

Ee-Chien Chang and S. Roy. Watermarking with Retrieval Systems. Workshop on Multimedia and Security at ACM Multimedia, Juan-Les Pins, France, 2002. (*Orals: Acceptance Rate: 11%*)

CONTENT ID
SOLUTIONS

Honghai Yu, Pierre Moulin and Sujoy Roy: RGB-D video content identification. pp. 3776-3780, IEEE ICASSP 2013

Praveen Kumar, Sujoy Roy and Ankush Mittal: OS-Guard: on-site signature based framework for multimedia surveillance data management. Multimedia Tools and Applications. 59(1): 363-382 (2012)

Qiming Li and Sujoy Roy. Secure Robust Hash Functions and Their Applications in Non-interactive Communications. International Journal of Digital Crime and Forensics 2(4): 51-62 (2010)

Qiming Li and Sujoy Roy. On the security of non-forgable robust hash functions. IEEE International Conference on Image Processing, 2008. (*Orals*)

Sujoy Roy, Qibin Sun and Ton Kalker. Performance analysis of locality preserving image hash. IEEE International Conference on Image Processing, 2008. (*Orals*)

Praveen Kumar, Sujoy Roy, Ankush Mittal, Padam Kumar. An On-site Signature based Framework for Audio-Visual Surveillance Data Management. National Conference on Communications, 2008

Sujoy Roy and Qibin Sun. Robust Hash for Detecting and Localizing Image Tampering, International Conference on Image Processing (ICIP), Vol. 6, pp. 117-120, San Antonio, Texas, USA, 2007. (*Orals*)

Sujoy Roy and Ee-Chien Chang. Robust Extraction of Secrets Bits from Minutiae, International Conference on Biometrics (ICB), Soul Korea, Lecture Notes in Computer Science, Vol. 4642, pp. 750-759, August, 2007. *Orals: (Acceptance Rate: 33/303)*

Sujoy Roy, X. Zhu, J. Yuan and E-C. Chang. On Preserving Robustness False Alarm tradeoff in Media Hashing. SPIE Visual Communications and Image Processing, San Jose, USA, 2007.

COMPUTER VISION AND PATTERN RECOGNITION Jackson Li, Sujoy Roy. Estimation of Affective Level in the Wild with Multiple Memory Networks. IEEE CVPR 2017 - Faces in the Wild Workshop (*Orals*)

Vipin Narang, Sujoy Roy, O. V. Ramana Murthy and Madasu Hanmandlu. Devanagari Character Recognition in Scene Images. ICDAR 2013: 902-906 (*Orals*)

O. V. Ramana Murthy, Sujoy Roy, Vipin Narang, Madasu Hanmandlu and Shorya Gupta: An approach to divide pre-detected Devanagari words from the scene images into characters. Signal, Image and Video Processing 7(6): 1071-1082 (2013)

O.V. Ramana Murthy, Sujoy Roy, Vipin Narang, Madasu Hanmandlu: Devanagari Character Recognition in the Wild, International Journal of Computer Applications, 38(4): 38-45 (2012)

Sujoy Roy. Region-based image registration for mosaicking. International Journal of Computer Applications in Technology 37(1): 59-73 (2010)

Sujoy Roy and Kong-Wah Wan. Identifying and learning visual attributes for object recognition. IEEE International Conference on Image Processing (ICIP) 2010: 3893-3896

Kong-Wah Wan, Ah-Hwee Tan, Joo-Hwee Lim, Liang-Tien Chia, and Sujoy Roy. A Latent Model for Visual Disambiguation of Keyword-based Image Search. In Proceedings of British Machine Vision Conference (BMVC), London, September 7-10, 2009.

Sujoy Roy and Sanjiv Kapoor. Region based image registration for wide-baseline stereo, Vol. 1 pp. 924-927, IEEE International Conference on Image Processing, Rochester, NY, USA, 2002.

MULTIMEDIA RETRIEVAL SYSTEMS Kong-Wah Wan, Wei-Yun Yau and Sujoy Roy. Metadata enrichment for news video retrieval: a graph-based propagation approach. ACM Multimedia 2013: 373-376

Sujoy Roy, Mun-Thye Mak and Kong-Wah Wan. Wikipedia Based News Video Topic Modeling for Information Extraction. International Conference on Multimedia Modeling (MMM) (2) 2011: 411-420

Kong-Wah Wan, Yan-Tao Zheng and Sujoy Roy. I^2R At ImageCLEF Wikipedia Retrieval 2010. CLEF (Notebook Papers/LABs/Workshops) 2010

MEDICAL ANALYTICS Sandeep Jain, Ankush Mittal and Sujoy Roy. Model-based image compression framework for CT and MRI images. International Journal of Medical Engineering and Informatics 3(1): 40-52 (2011)

R. Gupta, A. Mittal, K. Singh, V. Narang, S. Roy, WaVe-GPCR: Wavelet Variance Feature for Identification and Classification of GPCRs, IEEE Engineering in Medicine and Biology Mag.

D. Mahapatra, Sujoy Roy and Y. Sun. Retrieval of MR Kidney Images by Incorporating Spatial Information in Histogram of Low Level Features. IEEE International Conference on Biomedical Engineering, 2008.

R. Gupta, A. Mittal, K. Singh, V. Narang, S. Roy. Wavelet Variance Features for Identification and Classification of GPCRs using SVM, IAPR International Workshop on Pattern Recognition in Bioinformatics (PRIB), Singapore, 2007.

OTHERS

Sujoy Roy, Wan Kong Wah, Yau Wei Yun. Convergence of Televised Content and Game. Euro ITV 2011

S. Kashyap, Sujoy Roy, L. M. Lee and W. Hsu. FAPM : Feature Assisted Aggregate Pattern Mining of Trajectory Data. To appear in Proceedings of International Workshop on Spatial and Spatiotemporal Data Mining (SSTDm) - In conjunction with IEEE ICDM 2009.

J. Yuan, Sujoy Roy and Q. Sun. A Novel Framework for Improving Bandwidth Utilization for VBR Video Delivery over Wide Area Networks. SPIE Visual Communications and Image Processing, San Jose, USA, 2007.