

Pravin Kumar Rana

Contact Information

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Summary

- 10+ years of experience in embedded technology encompassing product research and development, agile project and team management, and algorithm development.
- 20+ granted and pending US patents, along with 10+ publications in referred journals and conferences in areas including gaze and eye tracking systems, stereoscopic and multi-view video, and image data processing.

Experiences

Tobii AB, Danderyd, Sweden

2020 – **Product Owner, XR Segment.**

- Leading a multidisciplinary team of engineers using Agile methodology to the end-to-end development of Tobii's next-generation off-axis eye tracking platform for XR, ensuring delivery of a high-quality platform that meets specified business and customer values within time and cost constraints.
- Delivered exceptional value to tier-1 tech companies by skillfully tailoring Tobii XR eye tracking solutions to precisely match customer needs, timeline, and provide meaningful customer-centric results

2016 – 2020 **Senior Algorithm Developer, XR segment.**

- Led a team of six or more computer vision algorithm developers as a technical lead and scrum master that successfully developed algorithms for Tobii VR4 eye tracking platform and performed custom adaptations to ensure a seamless integration of the platform into virtual reality headsets from various vendors, including **Tobii HTC Vive Development Kit, HTC Vive Pro Eye, StarVR One, Pico Neo 2 Eye, HP Reverb G2 Omnicept Edition, and Qualcomm Snapdragon Platforms**. Increased tier-one technology customer traction and sales were key indicators of the success of this project.
- Led end-to-end development and deployment of Tobii's VR4 eye-tracking platform's optical system calibration software for a tier-1 tech customer.
- Enhanced customer value by leading VR headset eye tracking integration projects, optimizing timelines, resources, and deliverables. Provided technical insights to engineering teams and collaborated with stakeholders to prioritize product focus.

2014 – 2016 **Senior Algorithm Developer, PC Segment.**

- Developed, enhanced, and customised to seamlessly integrated eye tracking algorithms for Tobii IS4 and IS5 platforms across a diverse range of devices, including **Tobii EyeX, SteelSeries Sentry, PCEye Mini, Eye Tracker 4C, Acer Predator 21X, Acer Aspire Nitro V 17, and Dell Alienware 17**, resulting in optimised product performance and improved user experience.

KTH Royal Institute of Technology, Stockholm, Sweden

2008 – 2014 **Graduate Researcher, ACCESS Linnaeus Center, School of Electrical Engineering.**

- Proposed innovative techniques for enhancing the 3D free-viewpoint TV experience as part of a joint KTH-Ericsson project. Introduced a structured depth-image-based rendering method and improved natural scene geometry estimation, resulting in a significant up to 4 dB improvement in rendered view quality. Recognised through ISO/IEC MPEG standardization report, 2 US patents, 2 peer-reviewed journal articles, and 7 peer-reviewed international conference proceeding
- Assisted with teaching and mentoring undergraduate and graduate students in multimedia signal processing, image and video processing, and information theory and source coding courses.

Government Polytechnic, Koderma, India

2005 – 2006 **Lecturer, Department of Physics.**

- Conducted lectures, laboratory sessions, and exams for approximately 50 introductory and upper diploma level students.

Education

[Indian Institute of Technology, Kharagpur, India](#)

2006 – 2008 **Master of Technology in Earth System Science and Technology.**

Grade 9.53/10.00 Cumulative Grade Point Average

Specialization Satellite Oceanography

Dissertation *Prediction of Antarctic sea ice edge using active contour model.*

- Employed satellite imagery and gradient vector flow to accurately model daily and monthly variations of the sea ice edge in Antarctica, achieving up to 90% accuracy.

[Ranchi University, Ranchi, India](#)

2002 – 2004 **Master of Science in Physics.**

Grade Graduated with first class first (71.81%)

Specialization Electronics and Communication

Dissertation *Study on general impedance converter and its application in realisation of second order active electronic resistor-capacitor-filters.*

- Implemented operational amplifier based general impedance converter circuit and used it to simulate different types of second-order active electronic resistor-capacitor filters

1998 – 2002 **Bachelor of Science (Honours) in Physics.**

Grade Graduated with first class (74.75%)

Certifications

[deeplearning.ai](#)

2018 **Deep Learning Specialization**, Andrew Ng, Coursera.

[University of Michigan](#)

2018 **Programming for Everybody**, Charles Severance, Coursera.

[Scrum Alliance](#)

2017 **Certified Scrum Master.**

[Indian Institute of Technology, Kharagpur, India](#)

2007 **Computer Network Management.**

Achievements

2021 – 2023 Recognised as a top performer at Tobii AB for consistently delivering exceptional results as a team member.

2016 – 2023 Received **20 US patent grants** as an inventor and co-inventor in the fields of gaze and eye tracking optical systems, stereoscopic and multi-view video, and image data representation and processing.

2006 – 2008 Received the prestigious **Ministry of Human Resource Development Scholarship** from the Government of India to pursue a Master of Technology degree at **Indian Institute of Technology, Kharagpur, India.**

2006 Achieved a top 5% rank (254 out of 4904) in India's competitive **Graduate Aptitude Test in Engineering**, an assessment by the Indian Government evaluating comprehensive understanding of engineering and science subjects for Master's Program admissions.

2004 Secured the top position in the Master of Science examination at Ranchi University, Ranchi, India.

2002 Ranked third in the Bachelor of Science examination from Ranchi University, Ranchi, India.

Competencies

[Management](#)

Methodology Agile Management

Tool Jira, Git, Confluence, Microsoft Office

[Technical](#)

Platform Linux, Windows, macOS

Libraries OpenCV, Python Imaging, Eigen

Programming C++, Python

Environments Eclipse, Visual Studio, CLion

Patents

Issued

- [1] P. K. Rana, "**Method, computer program product, control unit and head-mounted display for conserving energy in an eye tracking system**," Assignee: Tobii AB, US Patent 11,681,368, Jun. 2023.
- [2] T. Wang, G. Remon Salazar, Y. Wang, P. K. Rana, M. A. Ryan, J. Kron, and T. Sundberg, "**Gaze tracking using mapping of pupil center position**," Assignee: Tobii AB, US Patent 11,681,366, Jun. 2023.
- [3] M. Rosell, S. Johansson, P. K. Rana, Y. Wang, and G. Remon Salazar, "**Eye gaze tracking system, associated methods and computer programs**," Assignee: Tobii AB, US Patent 11,593,962, Feb. 2023.
- [4] Y. Wang, Y. Björk, J. Zachrisson, and P. K. Rana, "**Methods and device for detecting a shadow in a head mounted device**," Assignee: Tobii AB, US Patent 11,556,006, Jan. 2023.
- [5] T. Wang, P. K. Rana, Y. Wang, and M. A. Ryan, "**Detecting relocation of a head-mounted display**," Assignee: Tobii AB, Feb. US Patent 11,259,010, Feb. 2022.
- [6] T. Wang, G. Remon Salazar, Y. Wang, P. K. Rana, M. A. Ryan, J. Kron, and T. Sundberg, "**Gaze tracking using mapping of pupil center position**," Assignee: Tobii AB, US Patent 11,249,547, Feb. 2022.
- [7] P. K. Rana and Y. Wang, "**Method and system for glint/reflection identification**," Assignee: Tobii AB, US Patent 11,243,607, Feb. 2022.
- [8] P. K. Rana, M. G. Romero, R. Lundahl, and Y. Wang, "**Iterative point indexing**," Assignee: Tobii AB, US Patent 11,232,594, Jan. 2022.
- [9] M. A. Ryan, E. Lindén, J. Sjöstrand, and P. K. Rana, "**Updating a cornea model**," Assignee: Tobii AB, US Patent 11,061,473, Jul. 2021.
- [10] M. A. Ryan, T. Sundberg, P. K. Rana, and Y. Wang, "**Determining eye openness with an eye tracking device**," Assignee: Tobii AB, US Patent 10,852,531, Dec. 2020.
- [11] P. K. Rana and D. Torneus, "**Lens position adjustment in a wearable device**," Assignee: Tobii AB, US Patent 10,642,028, May 2020.
- [12] M. A. Ryan, T. Sundberg, P. K. Rana, and Y. Wang, "**Determining eye openness with an eye tracking device**," Assignee: Tobii AB, US Patent 10,394,019, Aug. 2019.
- [13] P. K. Rana, D. Torneus, and J. Andersson, "**Methods and system for controlling illuminators**," Assignee: Tobii AB, Jul. US Patent 10,342,425, Jul. 2019.
- [14] P. K. Rana and Y. Wang, "**Method and system for glint/reflection identification**," Assignee: Tobii AB, US Patent 10,324,529, Jun. 2019.
- [15] P. K. Rana and Y. Wang, "**Method and system for glint/reflection identification**," Assignee: Tobii AB, US Patent 10,288,879, May 2019.
- [16] M. Flierl, P. K. Rana, I. Girdzijauskas, T. Rusert, and A. Georgakis, "**Methods and arrangements for 3D scene representation**," Assignee: Telefonaktiebolaget LM Ericsson AB, US Patent 9,451,233, Sep. 2016.
- [17] I. Girdzijauskas, M. Flierl, and P. K. Rana, "**Method and processor for 3D scene representation**," Assignee: Telefonaktiebolaget LM Ericsson AB, US Patent 9,235,920, Jan. 2016.

Published

- [1] M. Rosell, S. Johansson, P. K. Rana, Y. Wang, and G. Remon Salazar, "**Eye gaze tracking system, associated methods and computer programs**," Assignee: Tobii AB, US Patent Application 18/159307, May. 2023.
- [2] V. Wase, E. Ljungzell, M. A. Ryan, C. Giordano, R. Lundahl, and P. K. Rana, "**Eye tracking system**," Assignee: Tobii AB, US Patent Application 17/459442, Mar. 2022.
- [3] P. K. Rana and G. Bianchi, "**Methods and systems for a head-mounted device for updating an eye tracking model**," Assignee: Tobii AB, US Patent Application 17/039918, Aug. 2021.

- [4] P. K. Rana, D. Torneus, and J. Andersson, “**Methods and system for controlling illuminators,**” Assignee: Tobii AB, US Patent Application 16/506398, Jun. 2022.
- [5] P. K. Rana, Y. Wang, and D. Torneus, “**An eye tracking system,**” Assignee: Tobii AB, SE Patent Application XXXXXX-X, 2022.
- [6] P. K. Rana, O. Glimaker, and M. Selin, “**Illuminator system for eye tracking system,**” Assignee: Tobii AB, SE Patent Application XXXXXX-X, Jan. 2023.
- [7] S. Johansson, M. Rosell, E. Ljungzell, R. Lundahl, S. Keshavdas, P. K. Rana, N. Zamani, and H. Wu, “**Convergence via IPD,**” Assignee: Tobii AB, US/SE Patent Application XXXXXX-X, Mar. 2023.
- [8] S. Keshavdas, R. Lundahl, P. K. Rana, and N. Zamani, “**An eye tracking system and methods of using an eye tracking system,**” Assignee: Tobii AB, US/SE Patent Application 2350840-1, Jul. 2023.

Publications

Preprints

- [1] P. K. Rana and M. Flierl, “**Inter-view depth consistency testing in depth difference subspace,**” *arXiv:2301.11752*, Jan. 2023.

Refereed journal articles

- [1] P. K. Rana, J. Taghia, Z. Ma, and M. Flierl, “**Probabilistic multiview depth image enhancement using variational inference,**” *IEEE Transactions on Selected Topics in Signal Processing, Special Issue on Interactive Media Processing for Immersive Communication*, vol. 9, no. 3, pp. 435 – 448, Apr. 2015.
- [2] Z. Ma, P. K. Rana, J. Taghia, M. Flierl, and A. Leijon, “**Bayesian estimation of Dirichlet mixture model with variational inference,**” *Pattern Recognition*, vol. 47, no. 9, pp. 3143 – 3157, Sep. 2014.
- [3] P. K. Rana, M. K. Dash, A. Routray, and P. C. Pandey, “**Prediction of sea ice edge in the Antarctic using GVF Snake model,**” *Journal of the Geological Society of India*, vol. 78, no. 2, pp. 99 – 108, Aug. 2011.

Refereed conference articles

- [1] P. K. Rana, J. Taghia, and M. Flierl, “**Statistical methods for inter-view depth enhancement,**” in *Proceedings of 3DTV Conference: In Pursuit Of Next Generation 3D Display (3DTV-CON)*, Special Session on Free-Viewpoint Television and Related Technologies, (Budapest, Hungary), pp. 1–4, Jul. 2014.
- [2] P. K. Rana, Z. Ma, J. Taghia, and M. Flierl, “**Multiview depth map enhancement by variational Bayes inference estimation of Dirichlet mixture models,**” in *Proceedings of IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, (Vancouver, Canada), pp. 1528–1532, May 2013.
- [3] P. K. Rana, J. Taghia, and M. Flierl, “**A variational Bayesian inference framework for multiview depth image enhancement,**” in *Proceedings of IEEE International Symposium on Multimedia (ISM)*, (Irvine, California, USA), pp. 183–190, Dec. 2012.
- [4] S. Parthasarathy, A. Chopra, E. Baudin, P. K. Rana, and M. Flierl, “**Denoising of volumetric depth confidence for view rendering,**” in *Proceedings of 3DTV Conference: The True Vision - Capture, Transmission and Display of 3D Video (3DTV-CON)*, (Zurich, Switzerland), pp. 1–4, Oct. 2012.
- [5] P. K. Rana and M. Flierl, “**Depth pixel clustering for consistency testing of multiview depth,**” in *Proceedings of European Signal Processing Conference (EUSIPCO)*, (Bucharest, Romania), pp. 1119–1123, Aug. 2012.
- [6] P. K. Rana and M. Flierl, “**View interpolation with structured depth from multiview video,**” in *Proceedings of European Signal Processing Conference (EUSIPCO)*, (Barcelona, Spain), pp. 383–387, Aug. 2011.

- [7] P. K. Rana and M. Flierl, “**Depth consistency testing for improved view interpolation**,” in *Proceedings of IEEE SPS International Workshop on Multimedia Signal Processing (MMSP)*, (Saint Malo, France), pp. 384–389, Oct. 2010.

Technical reports

- [1] A. Georgakis, P. K. Rana, and I. Radulovic, “**3DTV exploration experiments (EE1 & EE4) on the Lovebird1 data set**,” Tech. Rep. Telefonaktiebolaget L M Ericsson AB, M16977, MPEG ISO/IEC JTC 1/SC 29/WG, Xian, China, Oct. 2009.

Conference abstracts

- [1] P. K. Rana, A. Routray, M. K. Dash, and P. C. Pandey, “**Prediction of Antarctic sea ice edge using artificial intelligence**,” in *SCAR/IASC IPY Open Science Conference*, (St. Petersburg, Russia), Abstract S1.6/O28, Jul. 2008.

Dissertations

- [1] P. K. Rana, “**Prediction of Antarctic sea ice edge using active contour model**,” Master of Technology, Center for Oceans, Rivers, Atmosphere and Land Sciences, Indian Institute of Technology, Kharagpur, India, May 2008.
- [2] P. K. Rana and G. Mishra, “**Study on general impedance converter and its application in realization of second order active electronic resistor-capacitor-filters**,” Master of Science, University Department of Physics, Ranchi University, Ranchi, India, Jul. 2004.

Talks

- 2019 **Eye tracking in 5G era**, Tobii Develop Beyond, Tobii AB, Stockholm, Sweden
- 2017 **Tobii eye tracking VR development kit**, ACCESS Data Analytics Workshop, KTH Royal Institute of Technology, Stockholm, Sweden
- 2015 **Stereo vision based distance estimation in Tobii IS4 eye tracking platform**, Tobii Develop Beyond, Tobii AB, Stockholm, Sweden
- 2014 **Statistical methods for inter-view depth enhancement**, 3DTV Conference, Special Session on Free-Viewpoint TV and Related Technologies, Budapest, Hungary
- 2013 **Multiview depth map enhancement by variational Bayes inference estimation of Dirichlet mixture models**, IEEE International Conference on Acoustics, Speech, and Signal Processing, Vancouver, Canada
- 2012 **A variational Bayesian inference framework for multiview depth image enhancement**, IEEE International Symposium on Multimedia, Irvine, California, USA
- 2012 **Denoising of volumetric depth confidence for view rendering**, 3DTV-Conference, Zurich, Switzerland
- 2012 **Depth pixel clustering for consistency testing of multiview depth**, European Signal Processing Conference, Bucharest, Romania
- 2012 **Depth pixel clustering for consistency testing of multiview depth**, ACCESS PhD and Post-doc Workshop, KTH Royal Institute of Technology, Stockholm, Sweden
- 2011 **View interpolation with structured depth from multiview video**, European Signal Processing Conference, Barcelona, Spain
- 2010 **Depth consistency testing for improved view interpolation**, IEEE International Workshop on Multimedia Signal Processing, Saint Malo, France
- 2008 **Prediction of Antarctic sea ice edge using artificial intelligence**, SCAR/IASC IPY Open Science Conference, St. Petersburg, Russia
- 2008 **Prediction of sea ice edge by using image processing techniques**, Department of Wind Energy, Technical University of Denmark (DTU), Risø, Denmark

Media Coverage

- [1] A. Wahlberg and J. Koch, “**Free Viewpoint Television: Det nya TV-tittandet**”, *Osqledaren*, (Kårhuset Nymble, Drottning Kristinas väg 19, THS, Stockholm), no. 3, pp. 10 – 11, 2009/2010. (Swedish)