Avinash **Singh**

Assistant Professor, Hiroshima Astrophysical Science Center

Hiroshima University, Higashi-Hiroshima, Hiroshima 739-8526, Japan

avinash@hiroshima-u.ac.jp | https://singhavinash.net | sPaMFouR | avinash21292 | 0000-0003-2091-622X

Research Experience

Assistant Professor - Fixed Term (2.5 years) — *Hiroshima, Japan*

Hiroshima Astrophysical Science Center, Hiroshima University — *Apr 2021 - Present*

Research Associate - I (6 months) — *Nainital, India*

Aryabhatta Research Institute of Observational Sciences (ARIES) — *Sep 2020 - Mar 2021*

Post Doctoral Researcher (3 months) — *Bengaluru, India*

Indian Institute of Astrophysics (IIA) — *Jun 2020 - Aug 2020*

Teaching Experience

English for Physics - FY 2021 — *Hiroshima, Japan*

Hiroshima Astrophysical Science Center, Hiroshima University — *Apr 2021 - Aug 2021*

English for Physics - FY 2022 — *Hiroshima, Japan*

Hiroshima Astrophysical Science Center, Hiroshima University — *Apr 2022 - Aug 2022*

English for Physics - FY 2023 — *Hiroshima, Japan*

Hiroshima Astrophysical Science Center, Hiroshima University — *Apr 2023 - Aug 2023*

English Seminar for Globalisation A - FY 2022 — *Hiroshima, Japan*

Hiroshima Astrophysical Science Center, Hiroshima University — *11 Nov 2022*

English Seminar for Globalisation A - FY 2023 — *Hiroshima, Japan*

Hiroshima Astrophysical Science Center, Hiroshima University — *19 Jun 2023*

Education

Doctor of Philosophy (Ph.D.), Astronomy & Astrophysics — *Bengaluru, India*

Joint Astronomy Programme, Indian Institute of Science (IISc) — *Aug 2014 - Jun 2020*

- Supervisor - Prof. G.C. Anupama
- Thesis Title - Observational studies of Core-Collapse Supernovae
- Coursework CGPA - 6.4/8

Bachelor of Engineering (B.E.), Electronics & Communications Engineering — *Ranchi, India*

Birla Institute of Technology (BIT) — *Jul 2009 - Jun 2013*

- CGPA - 6.55/10

Higher Secondary Examination (12th) — *Port Blair, India*

Govt. Model Senior Secondary School — *2008-2009*

- All India Senior School Certificate Examination (AISSCE) - Central Board of Secondary Education (CBSE)
- Secured 95.8%

Secondary Examination (10th) — *Port Blair, India*

Navy Children School — *2006-2007*

- All India Secondary School Examination (AISSE) - Central Board of Secondary Education (CBSE)
- Secured 91.2%

Research Interests

1. Investigation of Core-Collapse Supernovae
2. Development of Data Reduction and Analysis Scripts/Pipelines
3. Investigation of Host-Environments of Core-Collapse Supernovae
4. Computing Volumetric Rates of Super Luminous Supernovae
5. Search for EM counterpart to GW sources

Technical Knowledge

Programming	Python, LaTeX, C++
Analysis Softwares	IRAF, ds9, Astrometry, Astromatic Suite (Sextractor, SCAMP, Swarp, PSFEx), Mathematica
Data Handled	3.8m Seimei Telescope, 3.6m Devasthal Optical Telescope, 2m Himalayan Chandra Telescope, 1.5m Kanata Telescope, 0.7m GROWTH-India, Swift UVOT, AstroSat UVIT, 2MASS, GalEX, Spitzer, Pan-Starrs
Platforms	Linux, Windows
Interests	Machine Learning, Data Science

Guiding/Co-Guiding Experience

Ketan Sand	Light Curves of Core-Collapse Supernovae - **(Summer Project Student - IIA)**
Sreepriya V.	Investigation of Low-Luminosity SN 2005cs - **(Visiting Student Research Program - IIA)**
Kyle Tregoning	Improving the expanding photosphere method - **(GROWTH Surf - University of Maryland and IIA)**
Brian Malkan	Optical Analysis of SN 2023ixf - **(Case Western University and Hiroshima University)**

Lead Author Publications

3) SN 2018hna: 1987A-like supernova with a signature of shock breakout — *ApJL, 882, L15*

Avinash Singh, D.K. Sahu, G.C. Anupama, Brajesh Kumar, Harsh Kumar, Masayuki Yamanaka et al. [25 authors] — *Sep 2019*

2) Observational signatures of circumstellar interaction and ^{56}Ni-mixing in the Type II Supernova 2016gfy — *ApJ, 882, 68*

Avinash Singh, Brajesh Kumar, Takashi Moriya, D.K. Sahu, G.C. Anupama, P.J. Brown, J.E. Andrews, N. Smith — *Sep 2019*

1) ASASSN-14dq: A fast-declining type II-P Supernova in a low-luminosity host galaxy — *MNRAS, 480, 2475*

Avinash Singh, S. Srivastav, Brajesh Kumar, G.C. Anupama, D.K. Sahu — *Oct 2018*

2nd-Author Publications

6) SN 2018gj: A Short-plateau Type II Supernova with Persistent Blue-shifted H-alpha Emission — *ApJ, 954, 155*

Rishabh Singh Teja, **Avinash Singh**, D.K. Sahu, G.C. Anupama, Brajesh Kumar, Tatsuya Nakaoka, Koji S Kawabata, Masayuki Yamanaka, Ali Takey, Miho Kawabata — *Sep 2023*

5) Far-Ultraviolet to Near-Infrared Observations of SN 2023ixf: A high energy explosion engulfed in complex circumstellar material — *ApJL, 954, L12*

Rishabh Singh Teja, **Avinash Singh**, Judhajeet Basu, G.C. Anupama, D.K. Sahu, Anirban Dutta, Vishwajeet Swain, Tatsuya Nakaoka, Utkarsh Pathak, Varun Bhalerao, Sudhanshu Barway, Harsh Kumar, Nayana A.J., Ryo Imazawa, Brajesh Kumar, Koji S Kawabata — *Aug 2023*

4) SN 2020jfo: A short plateau Type II supernova from a low mass progenitor — *ApJ, 934, 30T*

Rishabh Singh Teja, **Avinash Singh**, D.K. Sahu, G.C. Anupama, Brajesh Kumar, Nayana A.J — *May 2022*

3) Optical monitoring of the Type Ib Supernova SN 2017iro
Brajesh Kumar, **Avinash Singh**, D.K. Sahu, G.C. Anupama
ApJ, 927, 61
Mar 2022

2) SN 2017hpa: A carbon-rich type Ia supernova
Anirban Dutta, **Avinash Singh**, G.C. Anupama, D.K. Sahu, Brajesh Kumar
MNRAS, 503, 896
Feb 2021

1) ASASSN-16fp (SN 2016coi): A transitional supernova between Type Ic and broad-lined Ic
Brajesh Kumar, **Avinash Singh**, S. Srivastav, D.K. Sahu, G.C. Anupama
MNRAS, 473, 3776
Jan 2018

Co-Author Publications

17) Bridging between type IIb and Ib supernovae: SN IIb 2022crv with a very thin Hydrogen envelope
Anjasha Gangopadhyay, Keiichi Maeda, **Avinash Singh** et al.
ApJ - Accepted
Sep 2023

16) GROWTH on S190426c II: GROWTH-India Telescope search for an optical counterpart with a custom image reduction and candidate vetting pipeline
Harsh Kumar et al. [38 authors including **Avinash Singh**]
MNRAS, 516, 4517
Nov 2022

15) India's First Robotic Eye for Time-domain Astrophysics: The GROWTH-India Telescope
Harsh Kumar et al. [38 authors including **Avinash Singh**]
AJ, 164, 90
Sep 2022

14) Photometric calibrations and characterization of the 4Kx4K CCD Imager, the first-light axial port instrument for the 3.6m DOT
Amit Kumar, S.B. Pandey, **Avinash Singh** et al.
JApA, 43, 27K
Jun 2022

13) SN 2020sck: deflagration in a carbon-oxygen white dwarf
Anirban Dutta et al. [10 authors including **Avinash Singh**]
ApJ, 925, 217
Feb 2022

12) Photometric, polarimetric, and spectroscopic studies of the luminous, slow-decaying Type Ib SN 2012au
S.B. Pandey et al. [18 authors including **Avinash Singh**]
MNRAS, 507, 1229
Oct 2021

11) Intermediate Luminosity Type Iax SN 2019muj With Narrow Absorption Lines: Long-Lasting Radiation From a Possible Bound Remnant Predicted by the Weak Deflagration Model
Miho Kawabata, Keiichi Maeda, Masayuki Yamanaka, Tatsuya Nakaoka, Koji S. Kawabata, Kentaro Aoki, G.C. Anupama, Umut Burgaz, Anirban Dutta, Keisuke Isogai, Masaru Kino, Naoto Kojiguchi, Iida Kota, Brajesh Kumar, Daisuke Kuroda, Hiroyuki Maehara, Kazuya Matsubayashi, Kumiko Morihana, Katsuhiro L. Murata, Tomohito Ohshima, Masaaki Otsuka, D.K. Sahu, **Avinash Singh**, Koji Sugitani, Jun Takahashi, and Kengo Takagi
PASJ, 73, 1295K
Jul 2021

10) SN 2020ank - a bright and fast-evolving H-deficient superluminous supernova
Amit Kumar, Brajesh Kumar, S.B. Pandey, D.K. Sahu, **Avinash Singh**, G.C. Anupama, Amar Aryan, Rahul Gupta, Anirban Dutta, Kuntal Misra
MNRAS, 502, 1678
Jan 2021

9) Kilonova Luminosity Function Constraints based on Zwicky Transient Facility Searches for 13 Neutron Star Mergers
Mansi Kasliwal et al. [103 authors including **Avinash Singh**]
ApJ, 905, 145
Dec 2020

8) Optical studies of two stripped envelope supernovae SN 2015ap (Type Ib) and SN 2016P (Type Ic)
Anjasha Gangopadhyay et al. [17 authors including **Avinash Singh**]
MNRAS, 497, 3770
Jul 2020

7) Discovery and rapid follow-up observations of the unusual Type II SN 2018ivc in NGC 1068

ApJ, 895, 31

K.A. Bostroem et al. [47 authors including **Avinash Singh**]

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6) Flash ionization signatures in the Type Ibn supernova SN 2019uo

ApJ, 889, 2

A. Gangopadhyay et al. [29 authors including **Avinash Singh**]

Feb 2020

5) GROWTH on GW190425: Searching thousands of square degrees to identify an optical or infrared counterpart to a binary neutron star merger with the Zwicky Transient Facility and Palomar Gattini IR

ApJL, 885, L19

Michael Coughlin et al. [80 authors including **Avinash Singh**]

Nov 2019

4) SN 2017gmr: An energetic Type II-P supernova with asymmetries

ApJ, 885, 43

Jennifer E. Andrews , David J. Sand, Stefano Valenti, Nathan Smith, Raya Dastidar, D.K. Sahu, Kuntal Misra, **Avinash Singh**, Daichi Hiramatsu [and 68 others]

Nov 2019

3) On the observational behaviour of the highly polarized Type IIn supernova SN 2017hcc

MNRAS, 488, 3089

Brajesh Kumar, Chakali Eswaraiah, **Avinash Singh**, D.K. Sahu, G.C. Anupama, K.S. Kawabata, Masayuki Yamanaka, Ikki Otsubo, S.B. Pandey, Tatsuya Nakaoka, Miho Kawabata, Amar Aryan, Hiroshi Akitaya

Sep 2019

2) SN 2016B a.k.a ASASSN-16ab: a transitional type II supernova

MNRAS, 486, 2850

Raya Dastidar, Kuntal Misra, Mridweeka Singh, D. K. Sahu, A. Pastorello, Anjasha Gangopadhyay, L. Tomasella, S. Benetti, G. Terreran, Pankaj Sanwal, Brijesh Kumar, **Avinash Singh**, Brajesh Kumar, G. C. Anupama, S. B. Pandey

Jun 2019

1) The Fast, Luminous Ultraviolet Transient AT2018cow: Extreme Supernova, or Disruption of a Star by an Intermediate-Mass Black Hole?

MNRAS, 484, 1031

Daniel A. Perley, Paolo A. Mazzali, Lin Yan, S. Bradley Cenko, Suvi Gezari, Kirsty Taggart, Nadia Blagorodnova, Christoffer Fremling, Brenna Mockler, **Avinash Singh**, Nozomu Tominaga, Masaomi Tanaka [and 53 others]

Mar 2019

Talks & Posters In Conferences

Seimei Users Meeting 2023

Nagoya, Japan

Avinash Singh

20-22 Sep, 2023

- Talk: SN 2022jli : Multi-peaked Type Ic SN

Seimei Users Meeting 2023

Kyoto, Japan

Avinash Singh

12-13 Sep, 2023

- Talk: Photospheric phase evolution of SN 2023ixf

India/Japan internal collaboration meeting on transients and supernovae

Hiroshima, Japan

Avinash Singh

20-27 Mar, 2023

- Talk: Estimating Volumetric Rates of Transients

Exploring the Transients Workshop 2022

Tokyo, Japan

Avinash Singh

14-16 Dec 2022

- Talk: SN 2022ffg: Type IIn-L Supernova with a Plateau in the Ultraviolet Light Curve

Chile-Japan Academic Forum

Puerto Varas, Chile

Avinash Singh

28-30 Nov 2022

- Talk: Estimating Volumetric Rates of Transients using ZTF

Transient Workshop 2022, Japan

Takehara, Hiroshima, Japan

Avinash Singh

22-24 Nov 2022

- Talk: Applications of Machine Learning in Astronomy

Supernova Workshop 2021, Japan

Online

Avinash Singh

Dec 2021

- Invited Talk : Investigation of Core-Collapse and Super-luminous SNe

SuperVirtual 2021 *Online*

Avinash Singh, Brajesh Kumar, Keiichi Maeda, Masayuki Yamanaka, Tatsuya Nakaoka, Miho Kawabata, Koji Kawabata, D.K. Sahu, G.C. Anupama, Amit Kumar *Nov 2021*

- Poster : SN 2018hna: 1987A-like SN

20 years of Himalayan Chandra Telescope (HCT), Indian Institute of Astrophysics *Bengaluru, India*

Avinash Singh *Sep 2020*

- Invited Talk : Follow-up of Core-Collpase Supernovae from HCT

Astronomical Society of India (ASI-2020) Meeting, Indian Institute of Science and Research *Tirupati, India*

Shrutika Tiwari, N.K. Chakradhari, D.K. Sahu, Brajesh Kumar, **Avinash Singh**, G.C. Anupama *Feb 2020*

- Poster: ASASSN-16ex: An explosion similar to super-Chandrasekhar Type Ia Supernovae

Applications of Data Science in Astrophysics and Gravitational Wave Research, Indian Institute of Information Technology *Allahabad, India*

Anirban Dutta, G.C. Anupama, **Avinash Singh**, Brajesh Kumar, D.K. Sahu, Varun Bhalerao *Nov 2019*

- Poster: Photometric and Spectroscopic observations of Type-Ia Supernovae

Special Seminar, Hiroshima University *Hiroshima, Japan*

Avinash Singh *Oct 2019*

- Talk : Observational study of Type II SN 2016gfy

Time Domain Astronomy Workshop, Tohoku University *Sendai, Tohoku, Japan*

Avinash Singh *Oct 2019*

- Invited Talk : Observational study of Type II supernovae

Astronomical Society of India (ASI-2019) Meeting, CHRIST (Deemed to be University) *Bengaluru, India*

Avinash Singh *Feb 2019*

- Talk : Slow-declining Type II SN 2016gfy
- Poster: Optical monitoring of Type IIb SN 2017gkk [Brajesh Kumar, Avinash Singh et al.]

Indo-French School 3 - Spectroscopy & Polarimetry, CRAL-Observatoire de Lyon & IUCAA *Pune, India*

Avinash Singh, Athira S.K., Kaushal Sharma, Sorabh Chhabra, Mridusmita B., Fency *Jul 2017*

- Talk : Stellar Parameterization and Classification using Artificial Neural Networks (ANN)

Astronomical Society of India (ASI-2016) Meeting, Kashmir University *Srinagar, India*

Avinash Singh, Brajesh Kumar, G.C. Anupama, D.K. Sahu, Shubham Srivastav *May 2016*

- Poster: Optical observations of the Type IIP SN ASASSN-14dq

Schools & Workshops

ZTF Summer School - MultiMessenger Astrophysics *Minnesota, USA*

University of Minnesota *Jul. 2022*

- The school covered hands-on experience and training in processing data from ZTF and other transient survey data using modern data science techniques such as Bayesian inference, time-series analysis, and machine learning.

The 35th Jerusalem Winter School in Theoretical Physics: Physics of Astronomical Transients *Jerusalem, Israel*

Israel Institute of Advanced Studies (IIAS) *Dec. 2017*

- School covered general understanding of various transient events like GRBs, Supernovae, Novae, TDEs, etc.

Indo-French School 3 - Spectroscopy & Polarimetry *Pune, India*

CRAL-Observatoire de Lyon & Inter-University Centre for Astronomy & Astrophysics (IUCAA) *Jul. 2017*

- Project Work - 'Stellar Parameterization and Classification using Artificial Neural Networks (ANN)' (Guide - Dr. Kaushal Sharma, IUCAA)
- Learned basics of designing a spectrograph and a polarimeter

Data Intensive Science (DIS) Workshop *Pune, India*

Inter-University Centre for Astronomy & Astrophysics (IUCAA) *Feb. 2017*

- Workshop covered programming using Python, data visualization, machine learning, deep learning techniques, and big data methods.

Observational Proposals

Observation of low-redshift supernovae (ToO proposal) *2m HCT, Hanle, India*

2015 Cycle1, 2016 Cycle1, 2016 Cycle2, 2016 Cycle3, 2017 Cycle1

- PI - Shubham Srivastav
- Co-PI - **Avinash Singh**, Brajesh Kumar, G.C. Anupama, D.K. Sahu

Investigation of explosion site metallicity and CSM velocity of interacting transients. *2m HCT, Hanle, India*

2016 Cycle3

- PI - Brajesh Kumar
- Co-PI - Shubham Srivastav, **Avinash Singh**

Observation of Supernovae in the Nebular phase *2m HCT, Hanle, India*

2017 Cycle2, 2017 Cycle3, 2018 Cycle1, 2018 Cycle 2, 2018 Cycle 3, 2019 Cycle 1

- PI - **Avinash Singh**
- Co-PI - Shubham Srivastav, Brajesh Kumar, G.C. Anupama, D.K. Sahu

Observation of low-redshift supernovae (ToO proposal) *2m HCT, Hanle, India*

2017 Cycle2, 2017 Cycle3, 2018 Cycle1, 2018 Cycle 2, 2018 Cycle 3, 2019 Cycle 1, 2019 Cycle 2, 2019 Cycle 3

- PI - D.K. Sahu
- Co-PI - G.C. Anupama, **Avinash Singh**, Brajesh Kumar

Investigation of local environments of CCSNe and GRB host galaxies *2m HCT, Hanle, India*

2018 Cycle3, 2019 Cycle1, 2019 Cycle2, 2019 Cycle3

- PI - Brajesh Kumar
- Co-PI - **Avinash Singh**, G.C. Anupama, D.K. Sahu

Late phase Investigation of Supernovae. *3.6m DOT, Devasthal, India*

2020 Cycle2, 2021 Cycle1, 2021 Cycle2, 2022 Cycle 1, 2022 Cycle 2

- PI - D.K. Sahu
- Co-PI - **Avinash Singh**, Brajesh Kumar, G.C. Anupama, Anirban Dutta, Rishabh Teja

Investigating the observational properties of fast-evolving luminous transients *3.6m DOT, Devasthal, India*

2021 Cycle2, 2022 Cycle 1, 2022 Cycle 2

- PI - Brajesh Kumar
- Co-PI - **Avinash Singh**, D.K. Sahu, G.C. Anupama, Anirban Dutta, Rishabh Teja

Follow-up Observations of Supernovae and Explosive Stellar Transients *3.8m Seimei Telescope, Okayama, Japan*

2022B, 2023A

- PI - Keiichi Maeda
- Co-PI - **Avinash Singh**, Masaomi Tanaka, Masayuki Yamanaka, Tatsuya Nakaoka, Koji Kawabata, Nozomu Tominaga, Anjasha Gangopadhyay, Jiang Jian, Miho Kawabata, Kenta Taguchi, Tomoki Morokuma

Spectroscopic Follow-up for Rapid Transients Discovered by Tomo-e-Gozen High-Cadence Transient Survey *3.8m Seimei Telescope, Okayama, Japan*

2022B, 2023A

- PI - Tomoki Morukuma
- Co-PI - Keiichi Maeda, **Avinash Singh**, Masaomi Tanaka, Masayuki Yamanaka, Tatsuya Nakaoka, Koji Kawabata, Nozomu Tominaga, Anjasha Gangopadhyay, Jiang Jian, Miho Kawabata, Kenta Taguchi

Estimating Metallicities of Host Environments of Core-Collapse Supernovae *3.8m Seimei Telescope, Okayama, Japan*

2022B, 2023A

- PI - Masayuki Yamanaka
- Co-PI - **Avinash Singh**, Anjasha Gangopadhyay, Keiichi Maeda, Masayuki Yamanaka, Tatsuya Nakaoka, Koji Kawabata, Miho Kawabata, Kenta Taguchi

Investigating the Host Environments of 1987A-like Type II Supernovae arising from Blue Supergiants *8.2 m Very Large Telescope, Paranal - MUSE*

P112

- PI - **Avinash Singh**
- Co-PI - Joseph Anderson, Rishabh Singh Teja, Timo Kravtsov, Luc Dessart, Joseph Lyman, Lluis Galbany, Hanindyo Kuncarayakti

Extracurricular Activity

Let's Talk Astronomy - Community Outreach during COVID-19 Lockdown — *Online*

MEMBER — *Apr 2020 - Jul 2020*

- An astronomy outreach program conducting free online interactive sessions for school and college during COVID-19 lockdown
- The sessions were organized to give the students an overview of research in astronomy and explore the scientific and engineering challenges.
- We also discussed how to pursue research in astronomy and followed it up with a question-answer session.

Indian Institute of Astrophysics - Outreach Committee — *IIA Bengaluru, India*

VOLUNTEER — *Aug 2015 - Present*

- Spread awareness on research in Astronomy
- Conducting outreach in various schools (mostly government schools)
- Explaining usage of science in daily life with experiments and connecting them to astronomy

IIT Kharagpur - Kshitij-2011 Robotics Competition — *IIT Kharagpur, India*

PART OF A 4-MEMBER TEAM — *Jan 2011*

- Designed a manually controlled robot (water raft) that could retrieve objects from a flood-affected area (platforms) and bring them to safety
- Progressed till the 2nd stage of the competition

Honors & Awards

2009	**state Rank 1 (Secured 95.8%) in CBSE Board Examinations(12th),** Awarded by the Lieutenant Governor of Andaman and Nicobar	*Port Blair, India*
2009	**Certificate of Merit by CBSE (12th),** Secured 100% in Mathematics in CBSE Exams	*Port Blair, India*
2008	**1st Prize,** NCERT State Level Science Quiz Competition	*Port Blair, India*
2008	**NTSE Scholar,** National Talent Search Examination (NTSE)	*Port Blair, India*
2007	**Certificate of Merit by CBSE (10th),** Secured 100% in Mathematics in CBSE Exams	*Port Blair, India*

Additional Courses

Aug 2015	**An Introduction To Interactive Programming In Python - Part 2,** Rice University	*Coursera*
Jul 2015	**An Introduction to Interactive Programming in Python - Part 1,** Rice University	*Coursera*
Mar 2014	**Analysing the Universe,** Rutgers University	*Coursera*
Jan 2014	**Classical Mechanics,** Massachusetts Institute of Technology	*edX*
Dec 2013	**Electricity and Magnetism,** Rice University	*edX*
Nov 2013	**Calculus Two: Sequences & Series,** Ohio State University	*Coursera*
Oct 2013	**Physics 1 for Physics Majors,** University of Colorado Boulder	*Coursera*
Oct 2013	**Astronomy: Discovering the Universe,** Curtin University	*Open2Study*
Oct 2013	**From the Big Bang to Dark Energy,** University of Tokyo	*Coursera*
Sep 2013	**Astronomy: State of the Art,** University of Arizona	*Udemy*
Mar 2013	**Astrobiology and the search for Extraterrestrial life,** University of Edinburgh	*Coursera*
Jan 2013	**Introduction to Astronomy,** Duke University	*Coursera*

UnderGraduate Project

Analysing capacity improvements In wireless networks with the help of relays — *BIT, Mesra, Ranchi*

AVINASH SINGH, SHRADDHEYA PATHAK, GAURAV VATYANI

- Comparison of different path loss models in different human settlements: Urban, Suburban, Rural
- Goodput and path loss analysis for fixed node relay networks

Other Interests

Hobbies Astrophotography, Photography, Trekking, Birding

Sports Badminton, Table Tennis, Snooker, Volleyball, Football