Pranav Sanghavi

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Experience

Departement of Physics, Yale University — New Haven, CT, USA
Postdoctoral Associate — 2022–Current

Lane Department of Computer Science & Electrical Engineering, WVU — Morgantown, WV, USA
Graduate Research Assistant supervised by Dr. Kevin Bandura — 2016–2022

Raman Research Institute — Bangalore, Karnataka, India
Visiting Student Program advised by Dr. Avinash Deshpande — 2014 –2015

MSC.Software — Pune, Maharahtra, India
Intern with the Quality Assurance and technical validation Team for MSC.Nastran — May –July, 2012

- Performed installation testing on different Linux distributions [HPUX, AIX, Solaris et al.] as part of the QA (Quality Assurance) procedure for MSC.Nastran and received elementary training in Finite Elemental Analysis and CAE.

Education

West Virginia University — Morgantown, WV, USA
Ph.D. in Electrical Engineering, Advisor: Dr. Kevin Bandura — 2016–2022

- Dissertation: "Pathfinding Fast Radio Bursts Localizations using Very Long Baseline In- terferometry "

Vellore Institute of Technology — Vellore, Tamil Nadu, India
B.Tech. in Electronics and Instrumentation Engineering, — 2010–2014

- Thesis: "Investigation of Neural Networks for Flow Rate Approximation "

Projects

Teaching and Outreach Projects

- Digital Signal Processing in Radio Astronomy –Research Experience for Teachers — 2017 –Current
  I run the NSF funded Research Experience for Teachers Site — WVU
  - I taught Digital Signal Processing to high school teachers every summer using practical labs based on GNURadio. Additionally, helped them gain an in depth understanding of radio telescope instrumentation and radio astronomy by helping them build 21cm horn antennas along with their GNURadio based backends.
  - Created and maintain the web infrastructure to host lectures, laboratory exercises and lessons. Assisted teachers create lessons and have built along with them a website with lessons.
    see: `https://wvurail.org/dspira-lessons/`
  - Assist teachers conduct workshops virtually or visit their schools.
  - I lead monthly meetings with teachers and enthusiasts from across the country.
  - I maintain the GNURadio out-of-tree module software package tailored for radio astronomy
    see: `https://github.com/WVURAIL/gr-radio_astro`

Science and Engineering Projects

- CHIME Cosmology — 2022 –Current
  Crosstalk characterization — Yale

- TONE: A CHIME/FRB Outrigger Prototype — 2016 –Current
  Primary PhD thesis project advised by Dr. Kevin Bandura — WVU/GBO
  - I led the building of an array of 6m parabolic dishes at the Green Bank Observatory to serve as a VLBI station to achieve milli-arc-second localizations of one-off Fast Radio Bursts from a 3000+ km baseline.
  - I assembled, tested and debugged the analog chain including antennas, low noise amplifiers, RFoF transceivers.
  - Integrated and debugged the digital backend including the FPGA ICE boards and the baseband recorder server on site. Also set up the VLBI triggering system.
  - Worked on analysis of the baseband dump including, calibration, beamforming and cross correlation leading to the localization of the triggered pulses & Fast Radio Bursts.
  - Actively perform troubleshooting and Maintainence of the instrument.

- Visiting Student Program at Raman Research Institute — 2014 –2015
  Advised by Prof. Avinash Deshpande — RRI
  - Worked on a gamut of small projects helping in the "phase 0" of the Sky Watch Array Network (SWAN) with the primary goal of gaining a wide exposure to the field radio astronomy and instrumentation. Investigating the application of hough transforms to detect dispersed pulses.

- A Nuanced Thermal Analysis of a Proposed Living Space on Mars — 2014
  Advised by Prof. Satyajit Ghosh — VIT University
  - Running a PlanetWRF (Planet Weather Research and Forecast Model) Simulation of the Martian atmosphere & visualise the netCDF output using IDL(GDL) & MATLAB. The results were interpreted to choose a site for the living space on the surface, the materials & optimise the structural design.

- Investigation of Neural Networks for Flow Rate Approximation — 2014
  Advised by Prof. K. V. Lakshmi Narayana — VIT University
  - Bachelors Dissertation project in the domain of Artificial Neural Networks & Intelligent sensors culminating in an implementation on Field Programmable Gate Arrays (FPGAs)

- Development of Assistive Technologies for the Visually Impaired — 2013
  Advised by Dr. Theodore Moallem — VIT University

Large Collaborations

- **Canadian Hydrogen Intensity Mapping Experiment(CHIME):** Characterise receiver noise cross-talk.
- **Canadian Hydrogen Intensity Mapping Experiment/Fast Radio Burst (CHIME/FRB):** Primarily work with baseband data with specific focus on VLBI localization using outriggers. Service duties include helping with the online dissemination first CHIME/FRB catalog, being a team leader of one of four science result verification teams, among others. Help early phases of on site assembly and commissioning of the CHIME/FRB Outrigger site at GBO.
- **Hydrogen Intensity and Real-time Analysis eXperiment (HIRAX):** Assembly and testing of low noise amplifiers. The 6m Dish array at Green Bank Observatory –TONE has also serves as a HIRAX prototype array where it has been used for LNA testing, array calibration, characterization and drone experiments.

Technical Skills

- **Scientific and Astronomy computing:** High competence using the *Python* language along with extensive usage of *numpy, astropy, scipy* and other packages. Experience with *CUDA, pycuda* and *numba* for high performance computing. Worked with a multitude of astronomical data formats and have familiarity with HPC systems.
- **Programming Languages:** *C, Python, linux shell scripting, FORTRAN, IDL, NCL, MATLAB, Assembly.*
- **Engineering Skills:** Can execute basic workshop routines and am well versed in engineering drawing. Possess acute familiarity with electronics lab testing and measurement equipment. Trained in soldering electronics including surface mount components and the use of reflow machines. Extensive experience with Digital Signal Processing including working with software defined radio using GNURadio as well as Field Programmable Gate Arrays.
- **Web Development Technologies:** HTML, CSS, JavaScript & related JavaScript frameworks such as VueJS, etc.

Teaching

Student Mentoring

Undergraduate Students (WVU): Rhys Lockard, Andy Dyck, Jacob Hanni.

Workshops

- *2019 CASPER Workshop and PIRE Summer School* — August 2019
  Center for Astrophysics | Harvard & Smithsonian in Cambridge, MA, USA.
- NANOGrav spring 2017 student workshop — April 2017
  West Virginia University, WV, USA.
- ALMA proposal writing workshop — March, 2017
  West Virginia University, WV, USA.
- Green Bank Telescope Remote Observing Training School — October 2016
  Green Bank Observatory, WV, USA.

Public Outreach & Service

- Skype-a-Scientist — 2020-2021
  Video-Call Elementary, middle school classrooms
- McGill Physics Hackathon 2020 — 2020
  Judge
- Volunteer at the Celebrating Einstein event — April 2017
  Q&A for middle school students
- Volunteered for the WVU Center for Gravitational Wave & Cosmology outreach activities — 2017
  Mylan Park Elementary STEAM night & several other outreach opportunities in the community.
- English Teacher, Make A Difference (M.A.D), Vellore, Tamil Nadu, India. — 2012 –2013

Awards

- **Lancelot M. Berkeley – New York Community Trust Prize** — 2022
  Awarded by the AAS for meritorious work in astronomy as part of the CHIME/FRB team.

Science Talks & Presentions

- Fun Accompanying Radio Telescopes February 2, 2023.
  Invited talk at Yale Postdoctoral Association Pint of Postdocs Event, Yale University, New Haven, CT, USA.
- TONE: A CHIME/FRB Outrigger Pathfinder To Localize Fast Radio Bursts Using Very Long Baseline Interferometry January 10–14, 2023.
  Talk at USNC-URSI National Radio Science Meeting, University of Colorado, Boulder, CO, USA.
- TONE: 6m diameter 8 dish array as a CHIME/FRB outrigger testbed & proof of concept December 6–9, 2021
  Science at Low Frequencies VIII, online
- On Building Radio Telescopes: From Radio Astronomy for Classrooms to Detecting Fast Radio Bursts April 2021
  Public lecture for Marshall University's Faces of Physics Speaker Series.
- Digital Signal Processing in Radio Astronomy: An Interdisciplinary Experience 2019
  Talk at the 2019 IEEE Integrated STEM Education Conference (ISEC) at Princeton University, NJ, USA.
- An Instrumentation Design Framework to detect Fast Radio Bursts August 2017
  Poster at 32nd URSI GASS, Montreal, 19–26 August 2017.
- A Nuanced Thermal Analysis of a Proposed Living Space on Mars July 2014
  Poster at the Eighth International Conference on Mars held at Caltech, CA, USA.

Publications

2023 [1] Chime/Frb Collaboration, Mandana Amiri, Bridget C. Andersen, […], incl. **Pranav Sanghavi**, et al. **Feb. 2023**. "Erratum: "The First CHIME/FRB Fast Radio Burst Catalog" (2021, ApJS, 257, 59)". In: ApJS 264.2, 53, p. 53. DOI: 10.3847/1538-4365/acb54c.

[2] FRB Collaboration, Bridget C. Andersen, Kevin Bandura, […], incl. **Pranav Sanghavi**, et al. **2023b**. *CHIME/FRB Discovery of 25 Repeating Fast Radio Burst Sources*. arXiv: 2301.08762 [astro-ph.HE].

[3] **Pranav Sanghavi**, Calvin Leung, Kevin Bandura, et al. **Apr. 2023**. "TONE: A CHIME/FRB Outrigger Pathfinder for localizations of Fast Radio Bursts using Very Long Baseline Interferometry". In: *arXiv e-prints*, arXiv:2304.10534, arXiv:2304.10534. DOI: 10.48550/arXiv.2304.10534. arXiv: 2304.10534 [astro-ph.IM].

2022 [4] Kalyani Bhopi, Will Tyndall, **Pranav Sanghavi**, Kevin Bandura, Laura Newburgh, and Jason Gallicchio. **2022a**. "A Digital Calibration Source for 21 cm Cosmology Telescopes". In: *Journal of Astronomical Instrumentation* 11.04, p. 2250016. ISSN: 2251-1717. DOI: 10.1142/s2251171722500167.

[5] T. Cassanelli, Calvin Leung, M. Rahman, […], incl. **Pranav Sanghavi**, et al. **Jan. 2022**. "Localizing FRBs through VLBI with the Algonquin Radio Observatory 10 m Telescope". In: *The Astronomical Journal* 163.2, p. 65. DOI: 10.3847/1538-3881/ac3d2f. URL: https://doi.org/10.3847/1538-3881/ac3d2f.

[6] P. Chawla, V. M. Kaspi, S. M. Ransom, […], incl. **P. Sanghavi**, et al. **2022c**. "Modeling Fast Radio Burst Dispersion and Scattering Properties in the First CHIME/FRB Catalog". In: *The Astrophysical Journal* 927.1, p. 35. ISSN: 0004-637X. DOI: 10.3847/1538-4357/ac49e1.

[7] The CHIME/FRB Collaboration, Bridget C Andersen, Kevin Bandura, […], incl. **Pranav Sanghavi**, et al. **2022d**. "Sub-second periodicity in a fast radio burst". In: *Nature* 607.7918, pp. 256–259. ISSN: 0028-0836. DOI: 10.1038/s41586-022-04841-8.

[8] Devin Crichton, Moumita Aich, Adam Amara, […], incl. **Pranav Sanghavi**, et al. **2022e**. "Hydrogen Intensity and Real-Time Analysis Experiment: 256-element array status and overview". In: *Journal of Astronomical Telescopes, Instruments, and Systems* 8.1, pp. 1–19. DOI: 10.1117/1.JATIS.8.1.011019. URL: https://doi.org/10.1117/1.JATIS.8.1.011019.

[9] Zarif Kader, Calvin Leung, Matt Dobbs, […], incl. **Pranav Sanghavi**, et al. **Aug. 2022**. "High-time resolution search for compact objects using fast radio burst gravitational lens interferometry with CHIME/FRB". In: *Phys. Rev. D* 106 (4), p. 043016. DOI: 10.1103/PhysRevD.106.043016. URL: https://link.aps.org/doi/10.1103/PhysRevD.106.043016.

[10] Adam E. Lanman, Bridget C. Andersen, Pragya Chawla, […], incl. **Pranav Sanghavi**, et al. **2022g**. "A Sudden Period of High Activity from Repeating Fast Radio Burst 20201124A". In: *The Astrophysical Journal* 927.1, p. 59. ISSN: 0004-637X. DOI: 10.3847/1538-4357/ac4bc7.

[11] Calvin Leung, Zarif Kader, Kiyoshi W. Masui, […], incl. **Pranav Sanghavi**, et al. **Aug. 2022**. "Constraining primordial black holes using fast radio burst gravitational-lens interferometry with CHIME/FRB". In: *Phys. Rev. D* 106 (4), p. 043017. DOI: 10.1103/PhysRevD.106.043017. URL: https://link.aps.org/doi/10.1103/PhysRevD.106.043017.

[12] Daniele Michilli, Mohit Bhardwaj, Charanjot Brar, […], incl. **Pranav Sanghavi**, et al. **2022i**. *Sub-arcminute localization of 13 repeating fast radio bursts detected by CHIME/FRB*. arXiv: 2212.11941 [astro-ph.HE].

[13] **Pranav Sanghavi**. **2022j**. "Pathfinding Fast Radio Bursts Localizations using Very Long Baseline Interferometry". PhD thesis. West Virginia University.

2021 [14] M. Bhardwaj, A. Yu. Kirichenko, D. Michilli, […], incl. **Pranav Sanghavi**, et al. **2021a**. "A Local Universe Host for the Repeating Fast Radio Burst FRB 20181030A". In: *The Astrophysical Journal*. DOI: 10.3847/2041-8213/ac223b. URL: http://doi.org/10.3847/2041-8213/ac223b.

[15] The CHIME/FRB Collaboration, Mandana Amiri, Bridget C. Andersen, […], incl. **Pranav Sanghavi**, et al. **Dec. 2021**. "The First CHIME/FRB Fast Radio Burst Catalog". In: *The Astrophysical Journal Supplement Series* 257.2, p. 59. DOI: 10.3847/1538-4365/ac33ab. URL: https://doi.org/10.3847/1538-4365/ac33ab.

[16] A. Josephy, P. Chawla, A. P. Curtin, […], incl. **P. Sanghavi**, et al. **Dec. 2021**. "No Evidence for Galactic Latitude Dependence of the Fast Radio Burst Sky Distribution". In: *The Astrophysical Journal* 923.1, p. 2. DOI: 10.3847/1538-4357/ac33ad. URL: https://doi.org/10.3847/1538-4357/ac33ad.

[17] Calvin Leung, Juan Mena-Parra, Kiyoshi Masui, […], incl. **Pranav Sanghavi**, et al. **2021d**. "A Synoptic VLBI Technique for Localizing Nonrepeating Fast Radio Bursts with CHIME/FRB". In: *The Astronomical Journal*. DOI: 10.3847/1538-3881/abd174. URL: http://doi.org/10.3847/1538-3881/abd174.

[18] Ziggy Pleunis, Deborah C. Good, Victoria M. Kaspi, […], incl. **Pranav Sanghavi**, et al. **Dec. 2021**. "Fast Radio Burst Morphology in the First CHIME/FRB Catalog". In: *The Astrophysical Journal* 923.1, p. 1. DOI: 10.3847/1538-4357/ac33ac. URL: https://doi.org/10.3847/1538-4357/ac33ac.

[19] Masoud Rafiei-Ravandi, Kendrick M. Smith, Dongzi Li, […], incl. **Pranav Sanghavi**, et al. **2021f**. "CHIME/FRB Catalog 1 Results: Statistical Cross-correlations with Large-scale Structure". In: *The Astrophysical Journal*. DOI: 10.3847/1538-4357/ac1dab. URL: http://doi.org/10.3847/1538-4357/ac1dab.

2020 [20] P. Chawla, B. C. Andersen, M. Bhardwaj, […], incl. **P. Sanghavi**, et al. **2020a**. "Detection of Repeating FRB 180916.J0158+65 Down to Frequencies of 300 MHz". In: *The Astrophysical Journal*. DOI: 10.3847/2041-8213/ab96bf. URL: http://doi.org/10.3847/2041-8213/ab96bf.

[21] CHIME/FRB Collaboration, M. Amiri, B. C. Andersen, […], incl. **P. Sanghavi**, et al. **2020b**. "Periodic activity from a fast radio burst source". In: *Nature*. DOI: 10.1038/s41586-020-2398-2. URL: http://doi.org/10.1038/s41586-020-2398-2.

[22] CHIME/FRB Collaboration, B. C. Andersen, K. M. Bandura, […], incl. **P. Sanghavi**, et al. **2020c**. "A bright millisecond-duration radio burst from a Galactic magnetar". In: *Nature*. DOI: 10.1038/s41586-020-2863-y. URL: http://doi.org/10.1038/s41586-020-2863-y.

[23] Jeffrey B Peterson, Kevin Bandura, and **Pranav Sanghavi**. **2020d**. *Optimization of Radio Array Telescopes to Search for Fast RadioBursts*.

2019 [24] **Pranav Sanghavi**, Kevin Bandura, John Makous, and Howard Chun. **2019**. "Digital Signal Processing in Radio Astronomy: An Interdisciplinary Experience". In: *2019 IEEE Integrated STEM Education Conference (ISEC)*, pp. 362–366. DOI: 10.1109/ISECon.2019.8882039.

2018 [25] Ellie White, Richard Prestage, Evan Smith, and **Pranav Sanghavi**. **2018**. "Open Source Radio Telescopes". In: *Proceedings of the GNU Radio Conference*. Vol. 3. 1.

2016 [26] A. Jadeja, M.M. Jaiswal, S. Ghosh, and **P. Sanghavi**. **2016**. "Thermal comfort analysis of a proposed design for a sustainable living space on Mars". In: *Intelligent Buildings International* 8.4, pp. 215–233.

DOI: 10.1080/17508975.2015.1120185. eprint: https://doi.org/10.1080/17508975.2015.1120185. URL: https://doi.org/10.1080/17508975.2015.1120185.