Sattwik Basu

sattwik2@illinois.edu https://basusattwik.github.io sattwik-basu basusattwik

Education

University of Illinois Urbana-Champaign, Urbana, IL — *Aug 2022 – Present*
PhD in Electrical and Computer Engineering
Advisor: Prof. Romit Roy Choudhury

University of Rochester, Rochester, NY — *Aug 2016 – May 2018*
M.S. in Electrical and Computer Engineering
Advisor: Prof. Mark Bocko

K.M. Conservatory of Music, Chennai, India — *Oct 2014 – May 2016*
Performer's Certificate in Piano Performance

SRM University, School of Engineering, Chennai, India — *July 2010 – May 2014*
B.Tech. in Electrical and Electronics Engineering

Research Interests

I currently work on Generative Models—primarily **diffusion, flows**—and Markov Chain Monte Carlo methods. Specifically, I use these techniques to solve **inverse problems** (continuous and discrete). Prior to this, my focus was on developing multi-channel adaptive signal processing and ML algorithms for various audio applications.

Research Experience

Discrete Diffusion Posterior Sampling — *Urbana, IL*
University of Illinois Urbana-Champaign — *Jan 2026 – May 2026*

- Developed a fully discrete posterior sampler using a Langevin-inspired proposal distribution that operates entirely within the discrete simplex, ensuring the sampling trajectory never steps outside the discrete domain
- Designed the sampler to be agnostic to the training paradigm of the discrete diffusion prior, enabling integration with a broad class of discrete generative models.
- Applied the Discrete Diffusion Sampler to solve inverse problems across images (VQ-latents), music infilling, Reward-guided DNA-sequence generation, spatial mapping.

Diffusion/Flow Models for Inverse Problems — *Urbana, IL*
University of Illinois Urbana-Champaign — *May 2025 – Present*

- Built a diffusion-driven inverse framework for solving blind non-linear inverse problems with non-differentiable and potentially unknown forward operators.
- Designed a likelihood surrogate using contrastive training to guide a diffusion posterior sampler through non-smooth forward operators (e.g., path-planning algorithms). Theoretically showed that the InfoNCE based-surrogate is a valid approximation of the true likelihood score.
- Applied the blind inverse problem solver to spatial map inference from movement trajectories and blind audio restoration.

Parameter Estimation using Curvature-guided Langevin Monte Carlo — *Urbana, IL*
University of Illinois Urbana-Champaign — *Jan 2024 – Sept 2024*

- Proposed a *Curvature-guided Gaussian Smoothing* optimization strategy that utilizes the expected Hessian of the objective function to dynamically adapt the Langevin sampler, enhancing convergence rates and accuracy in non-convex optimization
- Demonstrated that the estimator outperforms classical signal processing techniques and both Vanilla and Annealed Langevin Dynamics
- Applied this method in Maximum-likelihood parameter estimation in noisy high-order polynomial chirp-signal mixtures.

Work Experience

PhD Research Intern *San Francisco, CA*
Dolby Laboratories Inc., Advanced Technology Group *May 2026 – Aug 2026*

- Researched methods for inverse problem solving using flow-matching/diffusion priors with applications in audio enhancement and upmixing
- Developed a technique to jointly restore and upmix degraded mono signals to stereo or 5.1 surround using reward-tilted flow priors (StableAudio 3). This work let to a patent filing and a paper submission.

Senior Audio DSP Engineer *Novi, MI*
Harman International, HALOsonic Innovation Group *Jan 2022 – June 2022*

- Invented adaptive algorithms for real-time music/speech interference cancellation and online secondary path IR estimation to prevent MFxLMS ANC systems from misadapting due to changes in cabin acoustics
- Led the R&D efforts on noise shaping and power scheduling for secondary path estimation algorithms

Audio DSP Engineer *Novi, MI*
Harman International, HALOsonic Innovation Group *July 2018 – Dec 2021*

- Designed a narrowband active road noise cancellation algorithm. Developed mathematical models to theoretically describe the tradeoffs between stepsize, leakage, notch response, and out-of-band noise boosting
- Invented a virtual mic ANC algorithm to reduce engine noise at locations far away from error microphones using an adaptive array processing algorithm. This technology helps in achieving better engine noise control performance in underdetermined MIMO ANC systems with reduced or non-optimum error mic placement

Research Intern, Audio Augmented Reality (AR) *Mountain View, CA*
Harman International, Future Experience Group *May 2017 – August 2017*

- Implemented beamforming and source separation algorithms using Non-negative Tensor Factorization (NTF) and Autoencoders, 8-9 dB SDR on speech/audio mixtures
- Prototyped an auditory AR system pipeline to selectively separate/supress audio sources and classify individual speech sources using Deep Learning

Publications

** denotes equal contribution*

Controllable Mono-to-Stereo Audio Upmixing using Reward-tilted Flows Sep 2026
S. Basu, G. Bhattacharya, A. Seefeldt
Under review, 2026

Discrete-Diffusion Posterior Sampling with Langevin-Inspired Proposals Sep 2026
C. Amballa*, **S. Basu***, J. Sampedro, R. Roy Choudhury
Advances in Neural Information Processing Systems (NeurIPS), Sydney, 2026

Discrete Langevin-Inspired Posterior Sampling July 2026
S. Basu*, C. Amballa*, J. Sampedro, R. Roy Choudhury
International Conference on Machine Learning (ICML), SPIGM Workshop, Seoul, 2026

Blind Audio Restoration using Contrastive Diffusion Guidance July 2026
S. Basu*, C. Amballa*, Z. Xu, J. Sampedro, S. Nelakuditi, R. Roy Choudhury
International Conference on Machine Learning (ICML), ML for Audio Workshop, Seoul, 2026

Inferring Indoor Layouts using Audio Feb 2026
Z. Yang, **S. Basu**, C. Amballa, D. Dutta, S. Nelakuditi, R. Roy Choudhury
ACM International Workshop on Mobile Computing Systems and Applications, Atlanta, 2026

Contrastive Diffusion Guidance for Spatial Inverse Problems Sept 2025
S. Basu*, C. Amballa*, Z. Xu, J. Sampedro, S. Nelakuditi, R. Roy Choudhury
International Conference on Learning Representations (ICLR), Rio de Janeiro, 2026

Can NeRFs "See" without Cameras? May 2025
C. Amballa, **S. Basu***, Y. Wei*, Z. Yang, M. Ergezer R. Roy Choudhury
Advances in Neural Information Processing Systems (NeurIPS), San Diego, 2025

Estimating Multi-Chirp Parameters using Curvature-guided Langevin Monte Carlo — Sept 2024
S. Basu, D. Dutta, Y. Wei, R. Roy Choudhury
IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), Hyderabad, 2025

Study of the Effects of Active Noise Cancellation on Music Playback — Sept 2021
S. Basu, J. Tackett, D. Trumpy, Adam Walt, S. Adari
SAE Technical Paper, Noise and Vibration Conference, Grand Rapids, MI, 2021

Musical Polyphony Estimation — May 2018
S. Basu, S. Kareer
Audio Engineering Society Convention 144, Milan, 2018

Bringing a Concert Home — Oct 2017
S. Basu, S. Kareer
Audio Engineering Society Convention 143, New York, 2017

Patents

Joint Audio Upmixing and Restoration using Generative Priors — Sep 2026
S. Basu, G. Bhattacharya, A. Seefeldt
US Patent App. 64/159,291

A Method for Generating an Imperceptible Stimulus Signal for Online Secondary Path Estimation — Sep 2023
K. Bastyr, **S. Basu**, J. Tackett, D. Trumpy
US Patent App. 18/462,223

An Adaptive Secondary Path Algorithm using IR Fingerprinting for Multichannel ANC Systems — Oct 2022
S. Basu, K. Bastyr, J. Tackett, D. Trumpy, G. Kim, T. Feng
US Patent 12230241

System and Method for Estimating Secondary Path Impulse Response for Active Noise Cancellation — Oct 2022
S. Basu, J. Tackett
US Patent 12249310

Virtual Location Noise Signal Estimation for Engine Order Cancellation — Nov 2021
S. Basu, J. Tackett, D. Trumpy, T. Tousignant, J. May
US Patent 11183166

Teaching Experience

Teaching Assistant — *Urbana, IL*
University of Illinois at Urbana-Champaign — *Jan 2024 – May 2026*
- ECE 498/598: Deep Generative Models
- ECE 101: Introduction to Digital Computing [**Outstanding Teacher Award**]

Teaching Assistant — *Urbana, IL*
University of Rochester — *Aug 2016 – Dec 2017*
- ECE 446: Digital Signal Processing
- ECE 140: Introduction to Music Engineering
- ECE 210: Circuits & Microcontrollers

Academic Service

Reviewer for ICLR 2027

Reviewer for IEEE ICASSP 2027, 2026

Reviewer for NeurIPS 2026

Reviewer for ICML SPIGM Workshop 2026

Reviewer for ICLR ReALM-GEN Workshop 2026

Skills

Languages: Python, MATLAB, C++, C

Deep Learning: PyTorch, Keras, NumPy, SciPy, Scikit-Learn, OpenCV, Librosa

Dev Tools: Microsoft Visual Studio, VS Code, Docker, Git, Jira, LaTeX

Vibroacoustics: HeadAcoustics Artemis

Hardware: TI C66, A15, ADI SHARCs, Function Generators, Oscilloscopes, Audiomatica Clio

Audio Tools: Logic Pro, ProTools, AudioMulch, Reaper, GarageBand, Audacity, Max/MSP, PureData

Awards

Best Poster Award at ACM HotMobile, Atlanta, 2026

Rated **Outstanding** in the UIUC **List of Excellent Teachers** (Spring 2025, Spring and Fall 2024)

Anna-Louise Baker Scholarship for excellence in piano performance, Eastman School of Music, 2017

Tuition scholarship from the Hajim School of Engineering, University of Rochester, 2016

Ranked 3rd in the state in the National Physics Olympiad, India, 2010