Richa Phogat | Curriculum Vitae

Department of Physics, – Indian Institute of Technology- Bombay, India

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Research Interests

Brainwave Dynamics

Exploring and characterizing the SSVEP/Entrainment patterns of human brainwaves as a function of stimulation intensity, frequency and contrast using Electroencephalography (EEG).

Statistical methods as tools to quantify brainwave dynamics.

Mesoscopic Neural Mass Models (NMMs) to predict new observations and explain already existing results on brainwave dynamics.

Nonlinear Dynamics

Stochastic Resonance: Signal enhancement by judicious interplay of the noise and system's nonlinearity,

Entrainment, oscillation quenching in dynamical systems, small world and random network dynamics, echo behavior in networks.

Education

Indian Institute of Technology-Bombay	**Mumbai**
PhD in Physics, CPI (out of 10) – 9.78	*2017–Present*
Thesis Topic: *Exploring Human Brainwaves: One flash at a time*	
Indian Institute of Technology-Bombay	**Mumbai**
Master of Science in Physics, CPI (out of 10) – 8.00	*2014–2016*
University of Delhi	**Delhi**
Bachelor of Science (Honours) in Physics, Percentage – 89.78%	*2011–2014*

Publications

Related to Doctoral Thesis

1: **Richa Phogat**, and P. Parmananda, "Provoking predetermined aperiodic patterns in human brainwaves". *Chaos: An Interdisciplinary Journal of Nonlinear Science*, 28(12): 121105, (2018).

2: **Richa Phogat**, Sudeshna Sinha, and P. Parmananda, "Echo in complex networks". *Physical Review E*, 101(2): 022216, (2020).

3: **Richa Phogat**, P. Parmananda, and Ashok Prasad, "Intensity dependence of sub-harmonics in cortical response to photic stimulation". *Manuscript Under Review*

4: "Effect of beta entrainment on parallel distributed information processing of the brain". *Manuscript Under Preparation*

Other Publications

5: Ishant Tiwari*, **Richa Phogat***, Animesh Biswas*, P. Parmananda and Sudeshna Sinha, "Quenching of oscillations in a liquid metal via attenuated coupling". *Physical Review E* 105(3): L032201, (2022). (* Equal Contribution)

6: **Richa Phogat***, Arnob Ray*, P. Parmananda, and Dibakar Ghosh, Phase coalescence in a population of heterogeneous Kuramoto oscillators. *Chaos: An Interdisciplinary Journal of Nonlinear Science*, 31(4): 041104 (2021). (* Equal Contribution)

7: **Richa Phogat**, Ishant Tiwari, Pawan Kumar, Marco Rivera, and P. Parmananda. "Cessation of oscillations in a chemo-mechanical oscillator". *The European Physical Journal B*, 91(6): 1-7, (2018).

8: Ishant Tiwari, Darshil Dave, **Richa Phogat**, Neev Khera, and P. Parmananda, "An alternate protocol to achieve stochastic and deterministic resonances". *Chaos: An Interdisciplinary Journal of Nonlinear Science*, 27(10): 103112, (2017).

9: Ishant Tiwari, **Richa Phogat**, P. Parmananda, J. L. Ocampo-Espindola, and M. Rivera. "Intrinsic periodic and aperiodic stochastic resonance in an electrochemical cell." *Physical Review E*, 94(2): 022210, (2016).

Technical Skills

EEG Data Acquisition, Analysis and Numerical Modelling

Numerical Modeling: (i) Bifurcation analysis of a physiologically inspired Jansen and Rit (J and R) Neuronal Mass Model (NMM) to analyze in greater detail the experimental results reported in publication # 3.

(ii) Increasing randomness in both static and dynamic networks using "Watts-Strogatz" algorithm. (Related to publication # 2).

Statistical Analysis: Eigenvalue analysis of the coupled Hindmarsh-Rose (HR) model of neuronal activity (Related to publication # 5), Principal Component Analysis (PCA), Entropy Calculations, Hypothesis Testing.

EEG Data Acquisition and Analysis: (i) Recording the human brainwaves using a 32 electrode EEG machine (Related to publications # 1, # 3 and #4).

(ii) Extensively use MATLAB to analyze and explore various statistical properties of this recorded EEG data (Related to publications # 1, # 3 and #4).

EEGLAB: Experience with EEGLAB toolbox of MATLAB for removing EEG artifacts, Independent Component Analysis (ICA) and for microstate analysis (Related to publications # 1 and # 3).

Video Analysis: Used MATLAB for video analysis to track the oscillations of a liquid metal as well as the light source used for entrainment of human brainwaves (Related to publications # 1, # 3 and #7) .

Hands on Experience

Clinical and Non-Clinical Population: Worked with both non-clinical and clinical population diagnosed with Attention Deficit Hyperactivity Disorder (ADHD) and Autism Spectrum Disorder (ASD) in the age range of 7-14 years (Related to manuscript # 4).

Electronics and Interfacing: Designed, built and interfaced with an in-house circuit to drive the photic stimulus (Related to publications # 1, #3 and #4).

Corrosion of Iron: Studied the electrochemical dissolution of Iron in presence of Sulfuric Acid as a nonlinear system for my Master's project (Related to publication # 9).

Chemo-mechanical oscillations of Liquid metal: Studied experimentally and numerically the oscillation quenching phenomenon in the "Mercury Beating Heart" system (Related to publications # 5 and #7).

Software Knowledge

Programming Languages: (In order of proficiency) MATLAB, Python, Fortran.

Software: (In order of proficiency) LaTeX, Inkscape, Blender

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Academic Service

Reviewed for Journals:: Physical Review E, Journal of Neural Engineering.

Extra Curricular

Community Service: Volunteered at "Abhyasika": a student run initiative of IIT - Bombay to improve literacy rate in socially marginalized communities.

Position of Responsibility: Department coordinator for placement cell at IIT-Bombay during the academic year 2015-2016.

YouTube channel "Perceptive Productions": Writer, Orator and co-creator for the YouTube channel "Perceptive Productions" ⌯ where we make relatively easy to understand videos on STEM topics.

Hobbies: I am an amateur equestrian still struggling with the gallop.

References

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○ **Ashok Prasad**
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Chemical and Biological Engineering
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