



B. P. Poddar Institute of Management & Technology
Department of Electrical Engineering

Report of Alumni Interaction Session on “Cooperative Control of Multi-agent Systems using Negative Imaginary Theory with Applications to Robotics”
Academic Year: 2021-2022

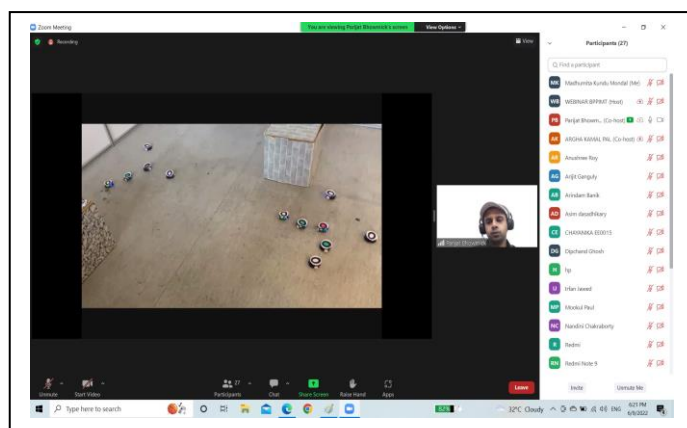
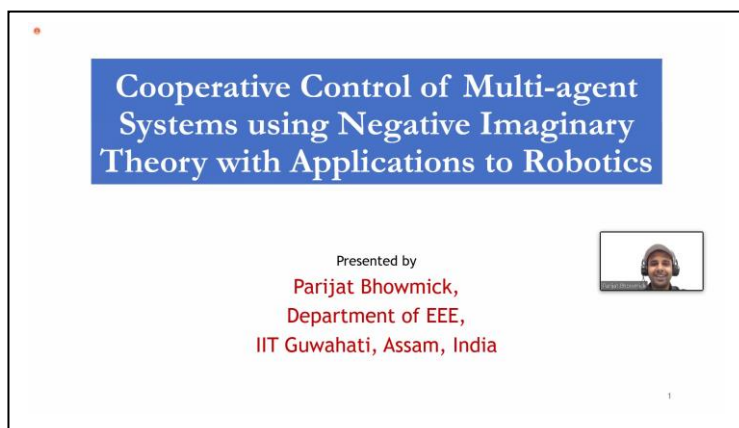
An Alumni Interaction Session was successfully conducted by the Department of Electrical Engineering, B. P. Poddar Institute of Management and Technology, Kolkata on “Cooperative Control of Multi-agent Systems using Negative Imaginary Theory with Applications to Robotics” on 09.06.2022 from 6pm onwards through Zoom virtual meeting platform. Dr. Parijat Bhowmick, an alumnus of EE, presently an Assistant Professor of IIT Guwahati, was invited to deliver a talk on the said topic.

Prior to joining his present position, Dr. Bhowmick, worked as a Postdoctoral Research Associate for three years at the Control Systems Centre, University of Manchester, UK. He completed his PhD degree in Control Engineering from IIT Kharagpur in the year 2018. He did his Master's from Jadavpur University in 2012 with the same specialization. He was a recipient of the University Gold Medal in ME and was also a recipient of the Institute Silver Medal during his B. Tech. He is an active researcher in the horizon of Robust control of uncertain systems, Negative Imaginary Systems theory, Vibration control of mechatronic systems, Cooperative Control of Multi-agent Systems (including Multi-Robot Systems) and Control of Smart/Micro-grid Systems.

The session was inaugurated by Dr. Nandita Sanyal, HoD, EE. Dr. Bhowmick, wonderfully explained some recent and interesting topics on Cooperative Control Scheme, Multi Agent Systems (MAS), Negative Imaginary (NI) Theory, application to Multi Robot Systems to all participants. He shared all experiences to our students and also motivated them by sharing his experience of his entire journey from college days to his present prestigious position. Students from 2nd, 3rd and 4th year of Department of Electrical Engineering attended the program.

Shrestha Paul, student of 3rd year anchored the entire sessions wonderfully.

Our faculties Mr. Argha Kamal Pal and Mr. Subhasish Das took the responsibility to organize the events smoothly. Dr. Parijat Bhowmick was felicitated by a Certificate of Appreciation. Session was ended with the vote of thanks given by Dr. Nandita Sanyal.



Examples of NI and SNI systems

NI (Nonlinear Interconnected) System:

Transfer function: $Y(s) = \frac{s^2 + 12.5}{s^3 + s^2 + 42.5s + 150} U(s)$

SNI (Semi-Linear Interconnected) System:

Transfer function: $\frac{Y(s)}{U(s)} = \frac{38.06188}{s^2 + 3.09481s + 38.06188}$

Modelling of Multi-agent Systems (MAS)

Agents

A networked multi-agent system

$$M(s) \begin{bmatrix} \vdots \\ 0 \\ \vdots \\ 0 \end{bmatrix} + (\mathcal{L} + P) \otimes I_n \begin{bmatrix} y \\ \vdots \\ y \end{bmatrix} = \begin{bmatrix} y \\ \vdots \\ y \end{bmatrix}$$

$M(s)$: Agent dynamics,
 \mathcal{L} : Laplacian matrix of the graph,
 P : Pinning-gain matrix,
 \otimes : Denotes Kronecker product.

Note: The interaction among the agents is modelled by an algebraic graph. The graph should either be connected if undirected, or should contain a spanning tree if directed.