भारतीय प्रौद्योगिकी संस्थान भुवनेश् वर
Indian Institute of Technology Bhubaneswar

Press Release

Understanding Schizophrenia through Chaos-Driven Dynamics: A Collaborative Breakthrough by IIT Bhubaneswar and NIMHANS, Bangalore

Bhubaneswar, 28th April 2026: In a significant interdisciplinary research collaboration, scientists from NIMHANS Bangalore, and IIT Bhubaneswar have developed a novel approach to understanding schizophrenia using chaos-driven dynamical systems. This pioneering study offers promising insights into brain function, disease progression, and potential treatment pathways for one of the most complex mental health disorders.

Mental health disorders affect nearly 15% of the global population, with schizophrenia being among the most severe due to its disabling symptoms and early onset, typically during late adolescence or early adulthood. This timing significantly impacts individuals during their most productive years. Understanding the biological and neural mechanisms underlying such disorders is essential for early diagnosis and the development of effective treatments.

Modern neuroscience recognizes mental illnesses as brain-based conditions involving dysfunction in neural networks, neurotransmitter imbalances, and structural abnormalities. To study these complexities, the research team employed functional magnetic resonance imaging (fMRI), a technique that measures brain activity by detecting changes in blood oxygen levels - known as the blood-oxygen-level-dependent (BOLD) signal.

The study focused on resting-state fMRI (rs-fMRI) signals to examine brain network dysfunction and synchronization patterns. These signals were analyzed using a specially designed chaotic dynamical system Each patient's brain signal uniquely influenced the system, enabling researchers to observe how brain activity evolves over time and responds to treatments such as antipsychotic medications, transcranial magnetic stimulation (TMS), and electroconvulsive therapy (ECT).

A key innovation of this research is the development of a Chaotic Dynamics Marker (CDM), which can assess disease recovery and guide treatment strategies. Notably, the study revealed that beyond a certain threshold, some treatments may have opposite effects on brain excitation, offering critical insights for personalized medicine.

The research introduces a unique dynamical system named U-KBBC, developed collaboratively by experts across psychiatry (at NIMHANS), and chemistry, materials engineering, electronics engineering and high performance computing at IIT Bhubaneswar. This system produces a distinct attractor pattern named "Sudarshan," which changes shape based on individual brain signals. These variations generate patient-specific markers, including CDM and a synchronization measure (SyncSZ), enabling detailed tracking of disease assessment, progression, and recovery.

The team at IIT Bhubaneswar also developed a portable electronic device, “Chinmoy,” embedded with the U-KBBC system, enhancing the potential for real-world clinical applications. A joint patent has been filed by NIMHANS Bangalore and IIT Bhubaneswar to protect this innovation.

This study is the first of its kind globally and represents a major step toward integrating advanced chaotic dynamics based models with clinical neuroscience. While the findings are promising, further validation through large-scale studies is underway. Beyond schizophrenia, the application of chaotic dynamics is expanding into other medical domains, including depression, epilepsy, cancer, and cardiovascular disorders.

This collaboration exemplifies the power of multidisciplinary and multi-institutional research in addressing complex health challenges. The team aims to extend this work across medical institutions in India and globally, contributing to improved diagnosis, treatment, and understanding of mental health disorders.