IDAPT HUB FOUNDATION
IIT (BHU) VARANASI

Under the aegis of
NM-ICPS, DST, Govt. of India

DATA ANALYTICS AND PREDICTIVE TECHNOLOGIES

DST@ 1971-2021

विज्ञान एवं प्रौद्योगिकी विभाग
DEPARTMENT OF
SCIENCE & TECHNOLOGY

Overview

I-DAPT- HUB FOUNDATION is a non-profit initiative at IIT (BHU) Varanasi acting as a nodal center and a Technology Innovation Hub (TIH) for technology development and entrepreneurial activities in "Data Analytics and Predictive Technologies (DAPT)" and other related areas under **National Mission on Interdisciplinary Cyber Physical Systems (NMICPS), DST, Govt. of India.**

The broader scope of this mission is to promote:

- Translational Research and Technology Development,

- Establishment of Centers of Excellence,

- Human Resource Development & Skill Development,

- Innovation, Entrepreneurship & Start-up Ecosystem and

- International linkages & collaborations in Research

I-DAPT-HUB FOUNDATION will collaborate with NSF in following thrust areas-

- Telecommunications

- Power

- Road Transport and Highways

- Health and Family Welfare

Mission and Vision

Mission

- The Mission is to support translational research and innovation in the identified thrust areas leading to the development of DAPT technologies and applications.

- To will support centers of Excellence (CoEs) in academic and research institutions across the country, in association with the industrial and financial sector, with significant economic and technical collaborations.

- To develop enterprise grade prototypes and proofs-of-concepts (PoC) following internationally standardized norms (e.g. IEEE, E.U.-ESO, FDA and others) and translate them into commercial products, in conjunction with industry and start-ups leading to significant job creation and economic growth, across the country and the globe.

Vision

The activities envisioned under this mission will provide a great fillip to societal betterment, via the development of new protocols, inventions of novel products/processes and services. The endeavor will also catalyse the creation of skilled young engineers, researchers, technicians, and entrepreneurs, together with human resource development at all levels, besides become a key contributor to realizing the vision of "Digital India", "Innovate in India", and "Make in India".

Activities (Research Projects, Publications, Patents, Grand Challenges, Short-term courses etc.)

Research Projects

- Prediction of Dose-Volume Histograms of Organs-at-risk in Prostate Cancer Radiation Therapy using   Machine Learning.

- Development of a scalable volatile organic compound (VOC) sensing based intelligent cyber physical system for near real-time vehicular pollution monitoring and recommendation for reduced emissions.

- Demonstrable Prototype of IoT enabled DC/AC Smart Grid at Library Building, IIT (BHU) Varanasi with Solar Photovoltaic Integration

- Data-driven battery sizing for standalone solar electric drive system for river boats

- Integrated computational and experimental studies to potential therapy of kala-azar targeting Dephosphocoenzyme A Kinase (LdDPCK) of the pathogen as a target

Publications

Sl. No.	Title of Publication	Authors	Published In
1.	Modified Transformerless Boost Derived Hybrid Converter with No Right Half-Plane Zero and Reduced Leakage Current	Simant Kumar Samal, R.K.Singh, and Ranjeet Mahanty	IEEE Applied Power Electronics Conference 2022, Houstan, Texas, USA
2.	Minimum Phase Hybrid Bipolar Converter for PV Integrated DC Microgrid Applications	Pawan Kumar, R.K.Singh, and Ranjeet Mahanty	IEEE Applied Power Electronics Conference 2022, Houstan, Texas, USA
3.	MPPT based Performance Analysis of Minimum Phase Multi-Output Hybrid Bipolar Converter	Pawan Kumar, R.K.Singh, and Ranjeet Mahanty	IEEE Applied Power Electronics Conference 2022, Houstan, Texas, USA
4.	An Improved Proportional Resonant Controller for Current Harmonics Reduction and Power Ripples Mitigation of Self-Synchronized Grid-tied PV System Under Distorted Grid Voltages.	Manash Kumar Mishra and Vivek Nandan Lal	IEEE Energy Conversion Congress and Exposition (ECCE), 2021, Vancouver, BC, Canada
5.	A Two-stage Standard On-Board Electric Vehicle Charger with Minimum Switch Count.	Soumya Ranjan Meher and R.K.Singh,	IEEE Energy Conversion Congress and Exposition (ECCE), 2021, Vancouver, BC, Canada
6.	Analysis of Maximum Power Point Tracking in four different modes for Multioutput Hybrid Bipolar Converter	Nidhi Malhotra, Pawan Kumar and R.K.Singh,	IEEE Energy Conversion Congress and Exposition (ECCE), 2021, Vancouver, BC, Canada
7.	Multi Output Hybrid Solar Inverter with no Right Half Plane Zero and Reduced Common Mode Leakage Current	Simant Kumar Samal, R.K.Singh, and Ranjeet Mahanty	IEEE Industry Applications Society Annual Meeting, 2021, Vancouver, BC, Canada
8.	An Advanced Proportional Multiresonant Controller for Enhanced Harmonic Compensation with Power Ripple Mitigation of Grid-Integrated PV Systems Under Distorted Grid Voltage Conditions	Manash Kumar Mishra and Vivek Nandan Lal	IEEE Transactions on Industry Applications (Volume: 57, Issue: 5, Sept.-Oct. 2021)

9.	Potential alternatives to current cholinesterase inhibitors: An in silico drug repurposing approach. Drug Development and Industrial Pharmacy	Debanjan Kundu and Vikash Kumar Dubey	https://doi.org/10.1080/03639045.2021.1952216 Publisher: Taylor and Francis
10.	Identification of high affinity and low molecular alternatives of boceprevir against SARS-CoV-2 main protease: a virtual screening approach	Subhomoi Borkotoky, Manidipa Banerjee, Gyan Prakash Modi, Vikash Kumar Dubey	Chemical Physics Letters https://doi.org/10.1016/j.cplett.2021.138446
11.	Repurposing of FDA-approved drugs as Autophagy Inhibitors in tumor Cells Journal of Biomolecular Structure and Dynamics	Kumari Prerna and Vikash Kumar Dubey	https://doi.org/10.1080/07391102.2021.1873862 Publisher: Taylor and Francis].

Patent

Indian Patent entitled "Adaptive Optimal Power Management Technique for Renewable Based Mix Energy System" Application No.: 202111031286
Inventors: Dr. R. K. Singh and Priyatosh Jena, Department of Electrical Engineering, IIT (BHU)
Status: Published

Overall Accomplishments

Short Term Courses

KEY SPEAKERS

Suhas Mansingh
VP (Engineering),
Cisco Systems

Prof. Shiho Kim
Director
Yonsei Institute of Convergence
technology, South Korea

Prashant Anand
Distinguished Engineer
NGN, Cisco Systems

Laxmi Mukund
Distinguished Engineer
NGN, Cisco Systems

Raghu Kulkarni
Technical Leader
Security, Cisco Systems

Prof. Dhananay Singh
CTO, Vestella Inc.
Hankuk University of Foreign
Studies (HUFS), Seoul, South Korea

6 more distinguished speakers are scheduled.

Next Generation Networks (NGN) & AI for Data Analytics and Predictive Technology Applications

(NGN & AI for DAPT)

One Week
Online Short-term Course
With live hands-on
(March 22-27, 2021)
Hosted by

CELEBRATING CENTENARY
100 years
IIT (BHU) VARANASI

in support with

CISCO

DST@ Department of SCIENCE & TECHNOLOGY

TLC
IIT (BHU)

PANDIT MADAN MOHAN MALAVIYA
NATIONAL MISSION ON TEACHERS AND TEACHING

and

A TECHNOLOGICAL INNOVATION HUB ON INTERDISCIPLNARY DATA ANALYTICS AND PREDICTIVE TECHNOLOGY
(IDAPT)

Short Term Course on
Data Analytics and Predictive Technology driven IoT based Smart Grid Infrastructure

A TECHNOLOGY INNOVATION HUB ON INTERDISCIPLINARY DATA ANALYTICS AND PREDICTIVE TECHNOLOGY (IDAPT) Under NATIONAL MISSION ON INTERDISCIPLINARY CYBER PHYSICAL SYSTEM (NM-ICPS)

1st–6th March 2021

Coordinator:- Dr. R. K. Singh
Co-Coordinator:- Dr. V. N. Lal

One Week Short Term Course On
Data Analytics and Predictive Technologies
05-10 July 2021

DEFENCE
POWER
DATA ANALYTICS AND PREDICTIVE TECHNOLOGIES
TELECOMMUNICATIONS
HEALTH

SUPPORTED BY

DST@

A TECHNOLOGICAL INNOVATION HUB ON INTERDISCIPLNARY DATA ANALYTICS AND PREDICTIVE TECHNOLOGY (IDAPT)

Short Term Courses

Short Term Course on

Data Analytics and Predictive Techniques for Urban Freight Transportation System (FTS)

A TECHNOLOGY INNOVATION HUB
ON
INTERDISCIPLINARY DATA ANALYTICS AND PREDICTIVE TECHNOLOGY (IDAPT)
Under
NATIONAL MISSION ON INTERDICIPLINARY CYBER PHYSICAL SYSTEM (NM-ICPS)

11th –14th November

Coordinators:- Dr. S Pratap
Dr. Lakshay

Short Term Course on

Advanced Techniques for Traffic Data Analysis, Visualization and State Estimation for Indian Cities

A TECHNOLOGY INNOVATION HUB
ON
INTERDISCIPLINARY DATA ANALYTICS AND PREDICTIVE TECHNOLOGY (IDAPT)
Under
NATIONAL MISSION ON INTERDICIPLINARY CYBER PHYSICAL SYSTEM (NM-ICPS)

21st –26th October 2021

Coordinators:- Dr. Ankit Gupta
Dr. Anilkumar Bachu

Data Collection and Analytics in Pavement Management Systems

Online Short-term Course

March 01-05, 2021

At

CELEBRATING CENTENARY
IIT (BHU) VARANASI

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A TECHNOLOGICAL INNOVATION HUB
ON
INTERDISCIPLNARY DATA ANALYTICS AND PREDICTIVE TECHNOLOGY (IDAPT)

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DEPARTMENT OF SCIENCE & TECHNOLOGY

Data Analytics and Predictive Technology for Intelligent Transportation Systems
(DAPT-ITS)

Online Short-term Course
March 15-19, 2021
Hosted by

CELEBRATING CENTENARY
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Supported by

A TECHNOLOGICAL INNOVATION HUB ON INTERDISCIPLNARY DATA ANALYTICS AND PREDICTIVE TECHNOLOGY
(IDAPT)

Short Term Courses

presents online webinar on

BIO STARTUPS

The journey from idea to reality

Saturday,
4th September, 2021
2:30 P.M. IST

- How to start a biotech company?
- Challenges with Startup
- Projected Growth in Biotech Sector

Indian Institute of Technology (BHU)

National Conference on Computational and Biochemical Drug Discovery [NCCBDD-2021]

September 11-12, 2021

Online conference jointly organized by

I-DAPT HUB FOUNDATION IIT (BHU), VARANASI
(A Section 8 - Not for profit Company)

भारतीय प्रौद्योगिकी संस्थान
काशी हिन्दू विश्वविद्यालय
IIT
INDIAN INSTITUTE OF TECHNOLOGY
BANARAS HINDU UNIVERSITY

and

Bioinformatics and Drug Discovery Society

Organizing Chairman
Prof. Vikash Kumar Dubey,
IIT (BHU) Varanasi

Computer Aided Drug Design and Protein Analysis

Online Short-term Course

February 22-26, 2021

At

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DST@ 1971-2021
DEPARTMENT OF SCIENCE & TECHNOLOGY

Advances in Medical Imaging

Online Short-term Course

March 15-19, 2021
At IIT (BHU), Varanasi

CELEBRATING CENTENARY
100 years
IIT (BHU) VARANASI

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TECHNOLOGICAL INNOVATION HUB ON INTER-DISCIPLNARY DATA ANALYTICS & PREDICTIVE TECHNOLOGY (IDAPT)

Sponsored by
Dept. of Science & Technology, Ministry of Science & Technology, Govt. of India

Short Term Courses

Collaborations

S. No.	First Party	Second Party	Date of Signing	Activities
1	I-DAPT-HUB FOUNDATION	Hughes Global Education India Private Limited	07-01-2021	Online training courses on AI
2	I-DAPT-HUB FOUNDATION	HDFC Bank Ltd.	15-01-2021	Vernacular and affordable learning platform for school students. 360-degrees tech and touch model named UDYAMITA to fosters rapid creation and development of nano/micro-entrepreneurs in the low-income/reverse-migrants/unemployed segment population
3	I-DAPT-HUB FOUNDATION	The Technology Innovation Hub at Indian Statistical Institute, Kolkata	21-06-2021	Joint activities such as seminars, workshops, conferences and training programmes etc. Undertaking collaborative research activities through participation in nationally and internationally funded projects
4	I-DAPT-HUB FOUNDATION	OPAL-RT TECHNOLOGIES INDIA PVT. LTD	08-10-2021	Development of test beds for various thrust areas Cloud based solution for power system studies and research. Development of digital twin technology.
5	I-DAPT-HUB FOUNDATION	Premas Biotech Pvt. Ltd	06-12-2021	Collaboration related to Biomaterial and tissue scaffold products, biomedical devices, support for vaccine and drug discovery products

- Jointly organizing **13th International Conference on Computing, Communication and Networking Technologies** with University of South Alabama, USA between July 10-12, 2022.

I-DAPT-HUB Grand Challenge

I-DAPT HUB Foundation will conduct I-DAPT-HUB Pitch challenge for startups, entrepreneurs and Innovators developing cutting-edge/Innovative technologies in **Power, Telecommunications, Defense research & development, Road transport and Highways, Health & Family welfare sectors.**

Key Research Personnel

Telecommunications	Power	Defense Research and Development	Road Transport and Highways	Health and Family Welfare

Dr. R. K. Singh
Associate Professor in Electrical Engineering
IIT (BHU), Varanasi

https://www.iitbhu.ac.in/dept/eee/people/rksingheee

Dr. Ankit Gupta
Associate Professor
Department of Civil Engineering
IIT (BHU), Varanasi

https://www.iitbhu.ac.in/dept/civ/people/ankitciv

Prof. V. K. Dubey
School of Biochemical Engineering
IIT(BHU), Varanasi

https://iitbhu.ac.in/dept/bce/people/vkdubeybce

Prof Prasun Kumar Roy

School of Biomedical Engineering

https://www.iitbhu.ac.in/dept/bme/people/pkroybme

Dr. N. S. Rajput
Associate Professor in Electronics Engineering
IIT (BHU), Varanasi

https://iitbhu.ac.in/dept/ece/people/nsrajputece

Prof. Rajiv Prakash
School of Material Sc. & Technology
IIT (BHU), Varanasi

https://iitbhu.ac.in/dept/mst/people/rprakashmst

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Timeline, Plan for new research activities, and Milestones

SI no.	Activity/Milestone	1st year				2nd year				3rd year				4th Year				5th Year			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
A1	Data collection, Literature review, and Preliminary System design	■																			
A2	Simulation and paper design of planned prototype	■	■																		
A3	Laboratory prototype design and development		■	■	■	■															
A4	Expert Driven New Knowledge Generation /Discovery (TRL5)				■	■	■	■	■	■	■	■	■	■	■	■					
A5	Development of products/ prototypes from existing Knowledge (By experts or teams) (TRL6)				■	■	■	■	■	■	■	■	■	■	■	■	■	■			
A4	Technology /product delivery in specific sectors (TRL7)															■	■	■	■	■	
A5	Yearly review of progress					■				■				■				■			
A6	Mid Term Review																				
A8	Preparation and Publication of final progress reports**			■		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

**Draft completion report for review (3 month prior to date of completion)

Priority Areas for new US India Collaborations

Data Analytics and Predictive Technologies (DAPT) is an emerging approach to produce transformative technologies and novel solutions for societal, national and global problems. The following are some of the generic technologies for which Indo-US collaboration will play a crucial role in development of DAPT:

- **System Design** – Understanding the Integration of Physical and embedded systems.

- **Communication** - Communication networks are an essential part of any DAPT as they interconnect the DAPT subsystems and components.

- **Security** – DAPT has been increasingly involved in fields ranging from aerospace, automobile, industrial process control, energy, healthcare, manufacturing and transportation, etc. where **secure operation** is one of the key concerns.

- **Privacy** - Understanding the impact of cyber-attacks on any **DAPT** and in the design and assessment of detection mechanisms.

These aforementioned technologies will be implemented for the Priority Thrust-areas identified by I-DAPT-HUB Foundation as -

- Telecommunications

- Power

- Road Transport and Highways

- Health and Family Welfare

Telecommunications:

Industry 4.0 is driving the trends for digital transformation. Digital transformation is the change associated with the application of digital technology in all aspects of human society.

Since everything can be digitized, transformed, transported and stored, the ubiquitous telecommunication infrastructure will also need its transformation into digital infrastructure.

There are following enabling technology for which India-US may collaborate for this massive transformation:

- Industry 4.0 – 5G hyper connection and innovative Air Interface

- Massive scale Transport- Ethernet/IP, TSN.

- Low Latency computing at network scale e.g. MEC

- Massive "softwarization" where applications are, converging to IT methods e.g. Virtualization etc.

Power/ Energy:

The India-US collaboration will undertake the technology development in Power/Energy using DAPT for environment friendly, smart home automation with the system of Internet of Things (IoT)-activated smart devices that can be controlled remotely. The activities envisioned under the DAPT will provide a great impetus to Smart Cities Mission in terms of environmentally friendly, reliable, efficient, and IoT activated optimum power generation/flow and thus, setting up a DAPT based smart grid for smart homes and cities.

The technological areas on which the research can be done for this work package are as follows:
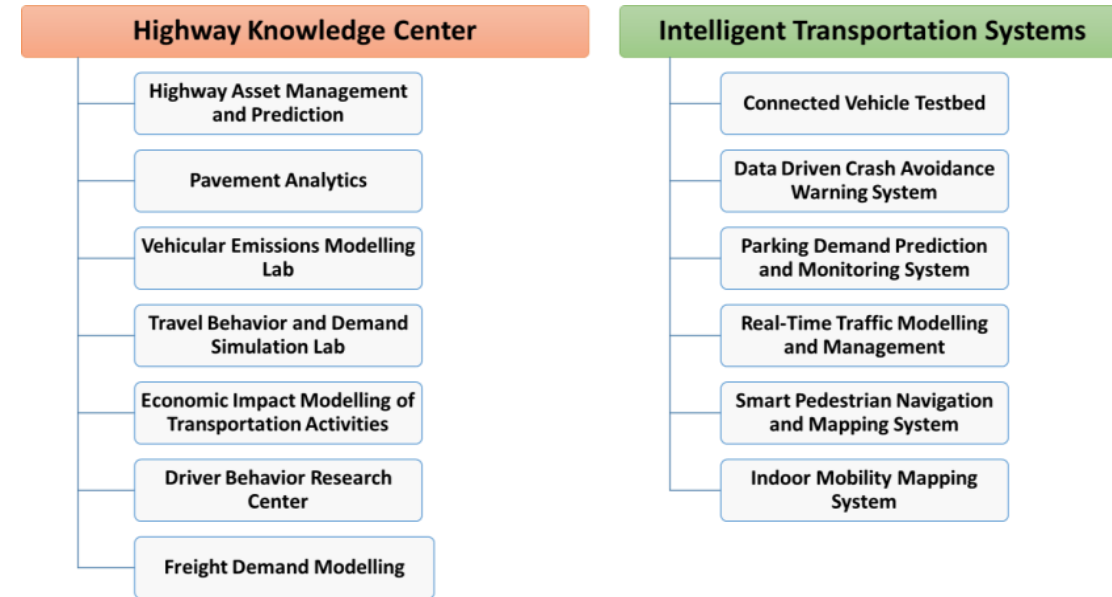
- Mix Energy Source Renewable Integration in Sustainable Smart Power Grid.

- Power Optimization in Smart Microgrid Infrastructure

- DAPT Driven IoT Based E-Vehicle Charging Infrastructure.

- Smart reconfigurable house

- IoT enabled demand response management in Power distribution system

Road Transport and Highways:

Transportation plays a vital role in transporting goods and services from one location to another in due estimated time. Smart mobility and transportation can be enhanced through data analytics and predictive technologies.

I-DAPT-HUB FOUNDATION proposes two major work plans where India-US researchers may collaborate –

1. Highway Knowledge Centre where a multitude of data would be collected, borrowed and fused together to support transportation decision making.

2. Intelligent Transportation Systems which includes testing relevant transportation algorithms and systems for real-time traffic management control system.

Highway Knowledge Center
- Highway Asset Management and Prediction
- Pavement Analytics
- Vehicular Emissions Modelling Lab
- Travel Behavior and Demand Simulation Lab
- Economic Impact Modelling of Transportation Activities
- Driver Behavior Research Center
- Freight Demand Modelling

Intelligent Transportation Systems
- Connected Vehicle Testbed
- Data Driven Crash Avoidance Warning System
- Parking Demand Prediction and Monitoring System
- Real-Time Traffic Modelling and Management
- Smart Pedestrian Navigation and Mapping System
- Indoor Mobility Mapping System

Health and Family Welfare:

In the present day health management scenario, the advent of Medical Expert Systems and the International Collaborative Epidemiology Programs have demonstrated the very reliable validated ability of "Data Analytics & Predictive Technologies". Thereby, one can enable:
- The automated forecasting of the most efficient therapy protocol, and
- Judicious selection and optimization of the most feasible therapeutic agents.
- IoT enabled biosensors and portable kits based health monitoring
- Sensors for air, water and food
- Data Analytics & Predictive Technologies in Population health monitoring

I-DAPT-HUB Foundation proposes the program of Brain/Mind Health for National Mission on DAPT focusing on harnessing these technologies for developing Neuro informatics Platforms for:
1. Development of tools and databases for management and sharing of neuroscience / psychometric data at all levels of analysis.
2. Construction of tools for analyzing and modelling neuroscience / cognitive data, in normality and disease.
3. Formulation of computational models of the human brain, its neuronal processes and cognitive / perceptual /subconscious operations

Keywords for Applications/Platforms:

- Power/ Energy
- Telecommunications
- Road Transport and Highways
- Health and Family welfare
- Environment and Sensors/ Bio-Sensors

Keywords for Research Areas:

- Power Electronic Interface
- Software-Defined Networking (SDN) and Fog Computing
- Neurocomputing
- Virtual Radio Access Networks (vRAN) for Hardware Abstraction
- Advance Polymer Composites
- Smart Grid Infrastructure
- Non Conventional Energy System
- Medical Devices