



PRESS RELEASE

IIT Mandi researchers optimize electronics design for better performance under fluctuating power

This research will extend the life of daily used electronic products such as Mobile phone, Laptop, Tablet and retain quality of performance over time

MANDI, 11th January 2021: Dr. Hitesh Shrimali, Associate Professor, School of Computing & Electrical Engineering, Indian Institute of Technology (IIT) Mandi, and his research scholar, Mr. Vijendra Kumar Sharma, along with Dr. Jai Narayan Tripathi from IIT Jodhpur have developed the performance analysis of miniaturized circuitry used in modern mobile devices such as mobile phones and tablets so that the devices may be designed for better performance even under erratic DC power supply. **The results of this work, funded by the Ministry of Electronics and Information Technology (MeitY), have been published recently in IEEE Open Journal of Circuits and Systems.**

“There is a need to understand the design equations that take into account the miniaturized parts of mixed electronic circuitry in order to improve the performance of the device and enhance the robustness of the components to power fluctuations”, says, Dr. Shrimali. His research team analyses the losses that occur due to the power supply fluctuations to optimize the design specifications of mobile devices in terms of speed, power, gain, distortion levels, among others.

The electronic circuitry in modern devices including mobile phones, laptops and tablets comprises both analog and digital components on a single semiconductor IC. Such mixed signal circuits are powered by a direct current supply, often from an in-built battery. While these batteries have low voltages (3.7 V), the individual components of the miniaturized circuitry of mobile devices operate at even lower voltages. For example, transistors used in many modern circuitries are as small as 7 nanometres – a 100000 times smaller than the width of a single human hair and require voltages far below 1 V to work. Power spikes and fluctuations in the power source can degrade the performance of the mixed circuit over time. Thus, any fluctuations in power of the battery can lead to significant performance deterioration. The designs of circuitry continue to use the concepts developed 20 years ago and have not considered the altered physics seen at nanometric size scales of modern electronics parts.

“Very Large-Scale Integration (VLSI) electronics are ubiquitous in today’s world, although we are not aware of it”, says Dr. Shrimali. Transceivers, antennae, amplifiers, Analog-to-Digital Converters (ADC), and Digital-to-Analog Converters (DAC) that are the heart of commonly used devices such as mobile phones, digital



music players, laptops and tablets require such optimizations in design to extend their life and retain quality of performance over time.

“We have used the matrix theory and closed form of equations for transistors to analyse the key design specifications for the design of electronics that use VLSI of miniaturized components”, explains the lead researcher.

After developing the method, the team has verified the proof-of-concept using two examples of output stages for analog and digital blocks in a standard 180 nanometre technology with 1.8 V of supply and same geometric area. Their models using the inspection method and the industry standard SPICE tools showed a maximum mean percentage error (MPE) of 3% for all the examples, which confirms the robustness of this approach in designing electronic components that are not adversely affected by power fluctuations.

The published research will improve the efficiency of high speed on-chip systems.

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About IIT Mandi

Since the first batch of 97 students joined in July 2009, IIT Mandi has grown to currently host 125 faculty and 1,833 students who are enrolled in various programmes of studies in undergraduate, postgraduate and research programmes, and 1516 alumni. IIT Mandi is a fully residential campus with 1.4 lakh sq. m. buildings completed. It has a guest house with 88 rooms, an 750-seater Auditorium, campus school, sports complex and hospital.

IIT Mandi has four Academic Schools and three major Research Centers. The Schools are: School of Computing and Electrical Engineering, School of Basic Sciences, School of Engineering, and School of Humanities and Social Sciences. The Centers are: Advanced Materials Research Centre (AMRC; set up with an investment of Rs. 60 crore), Centre for Design and Fabrication of Electrical Devices (C4DFED; has Rs. 50 crore worth of fabrication tools), and BioX Centre (has acquired research equipment worth Rs. 15 crore). In 2017, the Department of Biotechnology, Government of India, selected IIT Mandi to lead the prestigious Rs. 10 crore FarmerZone® Project.

To cater to the growing and changing needs of Indian industry and the aspirations of students, IIT Mandi has introduced 7 B.Tech., 7 M.Tech., 5 M.Sc., 4 Ph.D., 1 I-Ph.D and 1 M.A programmes in the past 10 years. The unique, project-oriented B.Tech. curriculum is centered around its 4-year long Design and Innovation stream. From August 2019, IIT Mandi started 3 new and unique B. Tech. programmes in Data Science and Engineering, Engineering Physics, and Dual Degree in Bioengineering.

Since the inception of the Institute, IIT Mandi faculty have been involved in over 275 Research and Development (R&D) projects worth more than Rs. 120 crore. In the past 10 years, the Institute has signed Memorandum of Understanding (MoU) with as many as 11 international and 12 national universities.



IIT Mandi Catalyst, first Technology Business Incubator in Himachal Pradesh, has helped over 75 startups since 2017 and is changing both the industry profile and entrepreneurial mindset in the state. So far, Catalyst has secured external funding of Rs. 24 crore from various funding agencies. Enabling Women of Kamand Valley (EWOK) is another innovative programme run by IIT Mandi, which focuses on imparting skills training to rural women to enable them to start village-scale businesses.

IIT Mandi has been ranked no. 31 in the Engineering Institutions Category in the [India Rankings 2020](#) released by National Institutional Ranking Framework, Ministry of Education, Govt. of India. Apart from this IIT Mandi is the only second generation IIT to be featured at rank no. 7 in the Atal Ranking of Institutions on Innovation Achievements, of the Innovation Cell, Ministry of Education, Govt. of India.

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