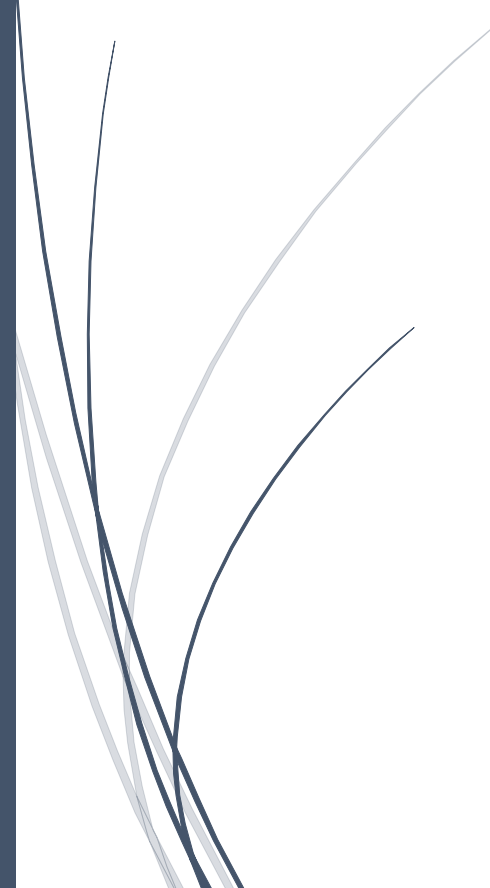


The logo for RADemics, featuring the text "RADemics" in white on a blue arrow-shaped background pointing to the right. The arrow is part of a larger blue horizontal bar that is attached to a dark blue vertical bar on the left side of the page.

RADemics

# AI-Driven Structural Health Monitoring of Buildings in Disaster-Prone Regions

A decorative graphic consisting of several thin, curved lines in shades of blue and grey, originating from the bottom left and extending upwards and to the right, resembling stylized grass or reeds.

K.Anbu , Kamunuri Ganapathi Babu  
K. M. College of Education, St. Martin's  
Engineering College

# AI-Driven Structural Health Monitoring of Buildings in Disaster-Prone Regions

<sup>1</sup>K. Anbu, Principal, Department of Physics, K. M. College of Education, Krishnagiri, Tamil Nadu, India. [Anbu.adpc@gmail.com](mailto:Anbu.adpc@gmail.com)

<sup>2</sup>Kamunuri Ganapathi Babu, Assistant Professor, Department of Computer Science and Engineering, St. Martin's Engineering College, Hyderabad, Telangana, India. [ganapathicse2@gmail.com](mailto:ganapathicse2@gmail.com)

## **Abstract**

The integration of Artificial Intelligence (AI) in Structural Health Monitoring (SHM) has revolutionized the way buildings in disaster-prone regions are assessed and maintained. AI-driven SHM systems leverage advanced machine learning and deep learning models to provide continuous, real-time monitoring, enabling the early detection of structural damage and the prediction of future risks. This chapter explores the role of AI technologies in enhancing the safety, resilience, and longevity of buildings, particularly in the face of natural disasters such as earthquakes, floods, and hurricanes. Key applications of AI, including predictive maintenance, real-time anomaly detection, and risk assessment, are examined in detail, highlighting their potential to transform the way infrastructure is managed in high-risk environments. Case studies demonstrate the practical implementation of these AI-driven solutions, showing their ability to improve decision-making and optimize resource allocation during disaster recovery. The chapter also addresses the challenges faced in integrating AI with existing infrastructure, such as data quality, real-time processing, and the need for human oversight in decision-making. With the continued advancements in AI and sensor technologies, the future of SHM in disaster-prone regions holds immense promise for creating safer, more sustainable built environments.

Keywords: Artificial Intelligence, Structural Health Monitoring, Predictive Maintenance, Disaster Management, Real-Time Monitoring, Risk Assessment.

## **Introduction**

The rapid evolution of Artificial Intelligence (AI) has introduced transformative capabilities across various industries, and one of its most significant applications is in the field of Structural Health Monitoring (SHM) [1]. In disaster-prone regions, where the risk of natural hazards such as earthquakes, floods, and hurricanes is heightened, the need for robust infrastructure monitoring has never been more critical [2]. Traditional methods of structural assessment often rely on manual inspections, which can be time-consuming, costly, and limited in scope [3]. In contrast, AI-driven SHM systems enable continuous, real-time monitoring of infrastructure, allowing for early detection of potential structural damage and the proactive management of building health [4]. By leveraging advanced sensors and machine learning algorithms, AI systems can process vast amounts of data, providing insights that allow for faster, more accurate assessments and timely interventions. These technologies hold the potential to revolutionize the way buildings in high-risk areas are managed and maintained, enhancing both safety and resilience [5].

One of the primary advantages of AI-driven SHM systems is their ability to detect subtle, early-stage damage that might otherwise go unnoticed with traditional inspection methods [6]. For example, AI algorithms can analyze data from a wide range of sensors, including accelerometers, strain gauges, and temperature sensors, to monitor minute changes in a building's structural health [7]. This early detection capability enables engineers to identify issues such as cracks, material degradation, and structural misalignments before they progress into more severe problems [8]. By catching damage at its nascent stage, predictive maintenance can be performed, reducing the likelihood of catastrophic failure during high-stress events such as earthquakes or extreme weather [9]. Early detection leads to cost savings, as smaller repairs can prevent the need for larger, more expensive interventions later on [10].

Another key benefit of AI in SHM is its ability to process large volumes of data from a wide array of sources in real time [11]. In the context of disaster-prone regions, real-time monitoring is essential for making informed decisions during and after a disaster [12]. In the event of an earthquake, for instance, AI algorithms can rapidly analyze seismic data, sensor readings, and even visual inputs from drones or satellites to assess the extent of structural damage [13]. The system can automatically identify areas of concern, prioritize those that require immediate attention, and alert decision-makers to take appropriate action [14]. This automation significantly speeds up the damage assessment process, enabling first responders to focus their efforts on the most vulnerable structures and improving the overall efficiency of disaster response [15].