Health Monitoring For Pavement System Using Smart Sensing Technologies

Background
Micro-Electromechanical Systems (MEMS) and wireless based sensor systems have vast potential to provide long-term, continuous, real-time and cost-effective Smart Pavement Structural Health Monitoring (SHM).

Objectives
- Evaluate the performance of off-the-shelf MEMS sensors and wireless sensors for monitoring in-situ concrete pavement
- Implement a wireless communication system to MEMS sensors for real-time and remote monitoring of concrete pavement system
- Identify limitations and system requirements for Smart Pavement SHM

Installation of Sensor System
RFID MEMS temperature tag MEMS Digital Humidity Sensor Thermochron iButton Longitudinal strain gage

Implementation of Wireless Sensor System
MEMS Sensor Data Reader (no memory function) MEMS Sensor XBee-PRO & Arduino Uno for Data Transmission

Requirements for Smart Pavement SHM
Selection of Sensors
A wireless multifunctional MEMS sensor with energy harvesting system and durable packaging shows a promise for smart pavement SHM

Installation of Sensors
Typical critical locations for concrete pavement
Packaging Sensors

Monitoring Sensors: Data acquisition
- Moving vehicle with data reader
- Onsite “hop” network
  - Combining RFID and ZigBee
  - Using cellular internet with a built in 3G/4G Hot-Spot

Importance of Research
Identifying limitations and system requirements of smart sensing technologies is crucial for continuous health monitoring and management of pavement systems which can make road infrastructure system more sustainable, smoother, and also safer

Acknowledgements: The authors gratefully acknowledge the Iowa Department of Transportation (IADOT), Iowa Highway Research Boards (IHRB), and Iowa State University (ISU) for supporting this study.