Quarterly Progress Report: Part II

Sol-Gel Corrosion Sensor System Trade-Off Design

Max Yen, Paul Lin, Dong Chen

College of Engineering, Technology, and Computer Science
Indiana University-Purdue University Fort Wayne

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Micro-Nano Technology So-Gel Corrosion Sensor System

PART II: Sol-Gel Corrosion System Design Report

II.1 Project Status

II.2 Sol-Gel System Architecture

II.3 Remote Wireless So-Gel Corrosion Sensor Node

II.4 Communication Subsystem

II.5 Sensor Data Server

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II. 1 Project Status: Accomplishments

- 1st Generation Sol-Gel Design
- Digital Scope + Function Generator Purchased
- 1st Generation Sol-Gel Sensor Tested
  - DC power source testing method
  - AC sine wave power source
- 4 Channel Corrosion Sensor Board – DC power source testing method
- AC 1 kHz sine wave signal generator for biasing sol-gel sensor: 1 st generation circuit designed

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Sol-Gel Corrosion Sensor Testing Circuit Design

- AC power supply 1 kHz, 1.5 volt peak-to-peak
- Digital scope with storage capability for measurement of voltage across the sol-gel sensor (Vc)
- Digital multimeter, for Sol-gel sensor cu current measurement (Ic - Alternating current)
- Sol-Gel Corrosion sensor in series with a 100 ohm current sensing resistor
- Formula of Sol-Gel Capacitance Calculation
  - Xc = Vc/Ic -- Reactance of Sol-Gel sensor in Ohm
  - $C = 1/(2\pi \cdot f \cdot Xc)$ – Sol-Gel capacitance in farad

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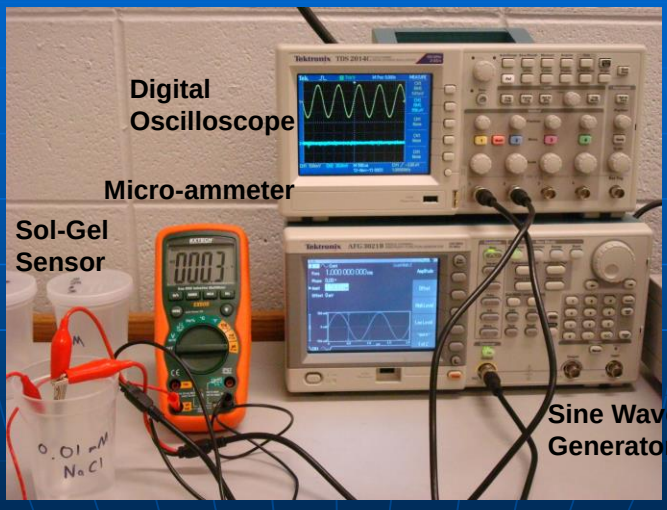
Sol-Gel Corrosion Sensor Testing Equipment



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Sol-Gel Corrosion Sensor Testing Equipment Demonstration

- Equipment setup
- Sensor placement
- Acquire readings
- Conduct calculation

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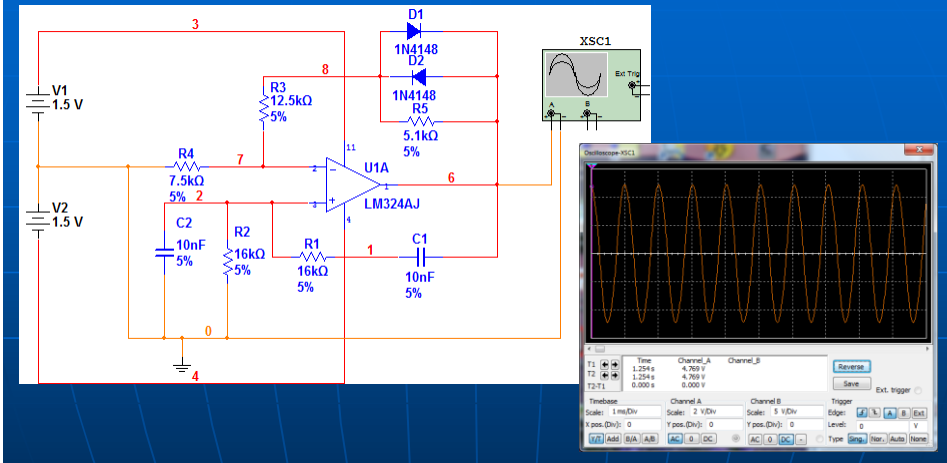
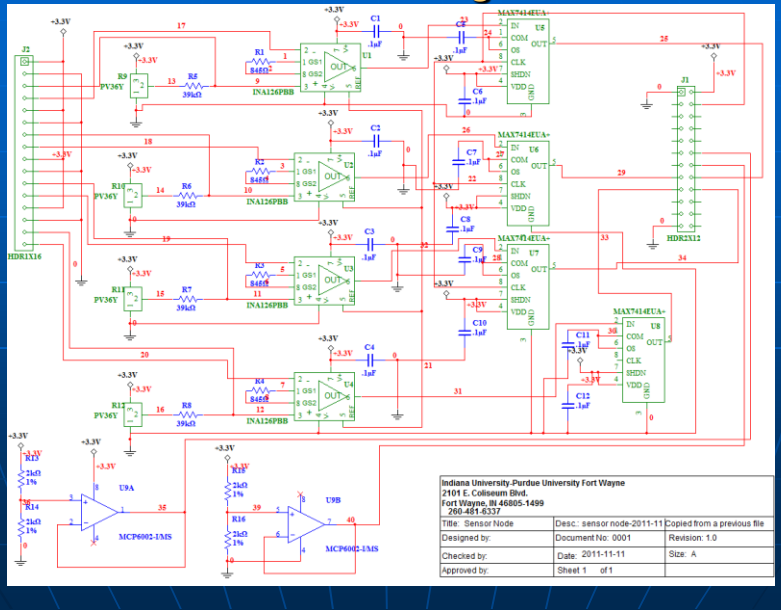
Sol-Gel Corrosion Sensor Node:
AC 1 kHz Sine Wave Generator Design



4 Channel Sensor Board: Analog Signal Processing



Wireless Corrosion Sensor Board (1st Trial)

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II. 2 Sol-Gel System Architecture

- Sol-Gel Corrosion Sensors (1 to 4): Remote nodes at fixed locations
- Base Station #1: Attach to CMS Arsenal Bridge Monitoring Service's Computer System
- Base Station #2: Attach to CERL: Sol-Gel Corrosion Data Server
- CERL – Sol-Gel Sensor Data Server
- Internet Gateway
- Power Sources

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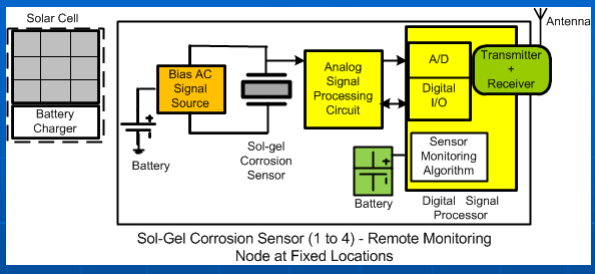
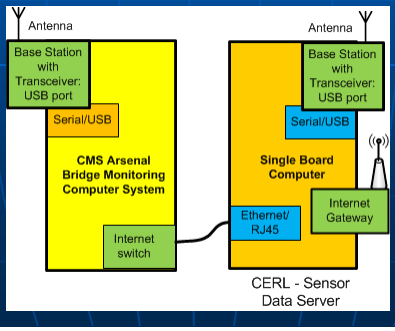
II. 2 Sol-Gel System Architecture (cont.)



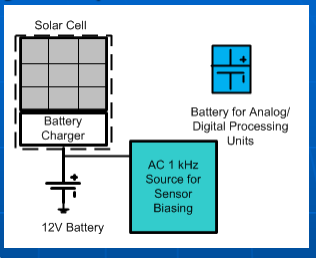
Sol-Gel Corrosion Sensor (1 to 4) - Remote Monitoring Node at Fixed Locations



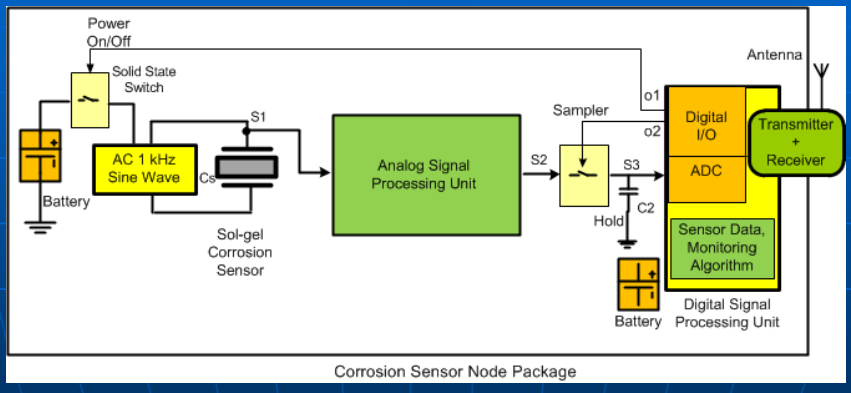
CERL - Sensor Data Server

II. 3 Remote Sol-Gel Corrosion Sensor Node (Power Source Subsystem)

- **Solar power panel and control (20 W)**
- **DC battery power source (12 V 37 AH)**
- **Power Source Requirement (~ 5 W)**
  - Sol-Gel sensor bias AC signal source (sine wave)
  - RF power source requirement estimation (1 W)
  - Sol-gel sensor power requirement (1 W)
  - Analog signal processing unit power requirement (0.5 W)
  - Digital signal processor (0.5 W)



Sol-Gel Corrosion Sensor Node Design



Analog Signal Processing Unit Design

- Signal generation circuit
- Signal conditioning
- Low pass filter
- Sample/Hold

Sensor Node Program Development

- MCU, A/D, Digital I/O, RF Transceiver
- A/D data acquisition, raw data storage
- Program development tool: C Language, etc.
- Network programming
- Data manipulation
- Data transmission
- Power source control

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III. 4 Communication Subsystems

- USB – Sensor node programming
- USB – Base Station
- Sensor node ⇔ Base Station (RF 900 MHz – 2.4 GHz)
- Ethernet: RJ 45
- Internet Gateway

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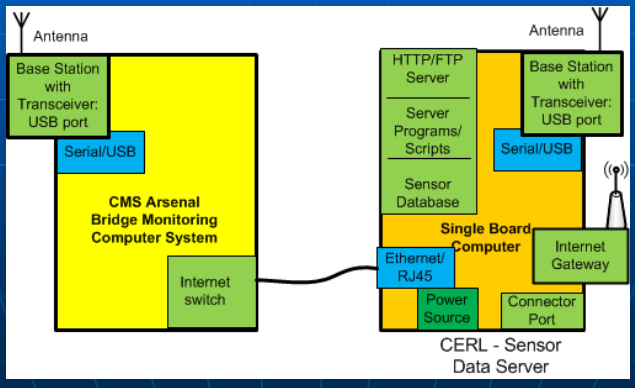
Base Stations for Corrosion Sensors

- Base Station #1: USB port => attach to CMS Arsenal Bridge Monitoring Service Computer System
- Base Station #2: USB port => attach to Single Board Computer at CERL Sensor Data Server



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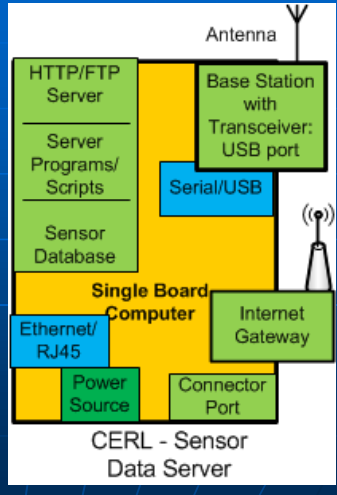
II. 5 CERL – Sol-Gel Corrosion Data Server

- Tiny Single Board Computer
  - HTTP Web server
  - FTP file server
  - Sensor data Base
  - Server scripts/programs
  - Data manipulation programs
- Internet Gateway
- USB/Serial interface



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Server Scripts/Programs

- Server setup and maintenance
- Database setup
- Database connectivity
- Database query
- Internet gateway and communications
- Web server activities
- Sensor node control, data access
- Web client interaction

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