Integrating Scalable Roadway-Level Flood Warning Sensors with Dynamic 2D Floodplain Modeling: A "Bottom-Up" Approach

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In the News





May 8th, 2019 Rainfall Events (Grimes County)

"Gedon Bowman with **Grimes County** Road and Bridge says due to flooding, they've been **shutting down roads all day**. 'We have been putting out 'High Water' signs road closed signs. **There is just water everywhere**,' says Bowman. It's not just the FM and County Roads flooding. Water is only a few feet away from parts of Highway 30."



Harris County Stream Gage Network



Motivation

- Inform roadway closures
- Have stream gauges (1D measurements)
- → <u>Need</u> overland gauges (2D measurements)
- Improved OEM/Citizen MOBILITY
- Notify at Neighborhood-Block Levels
- → <u>Cost</u> of traditional gages
- → <u>Ground truthing</u> forecast models
- → <u>Serve</u> rural and under gauged communities





Motivation Information "Gaps" in the Flood Warning Timeline







Motivation Standard Stream Gauge Network

Studied Streams

& ASSOCIATES, LLC







Flood Notification: The "Bottom-Line"

- → <u>A</u>nalyze data
- → <u>Map flood risks in real-time</u>
- <u>Communicate flood hazard information</u> to emergency managers and the greater public
- - Evacuation
 - Flood gate operation
 - Protection of property



KHOU



Houston OEM



Modern Day Flood Warning Systems ...









Thinking Outside the Stream Overbank







Re-Imagine Flood Gauge Signage *The "Bottom Up" Approach for Unstudied Crossings, Neighborhoods, and & Rural Areas*







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Trends in Road Signage





Re-Imagine Flood Gauge Signage The "Make Over" (Proof-of-Concept)

Led Lights FEE - Willy

Control Box

Capacitance Based Water Sensor ("Wet/Dry")

Cell Phone Home Screen A 🛈 🐃 😄 A 🛓 🛓 🗚 💐 🦡 📶 100% 🛢 12:31 AM 0 Settinas Outlook Banking ... Calculator Amazon TheCloud Email FLOOD WATCH: High water likely at E. Villa Maria and Ho ne **Burton Creek!** 8:10 PM Play Store +Enter message C:P SMS Text Message Notification Phone Chrome Telegram Camera Apps

Re-Imagine Flood Gauge Signage The "Make Over" (Proof-of-Concept)

Led Lights

DRRES



Control Box

---> Pros

- Lack of moving parts
- Operates in "sleep mode" (long battery usage, 9 to 12 months)
- Can retrofit existing signs
- Wet/Dry Notification
- Can add more sensors in series to indicate depth
- --> Cons
 - Needs improved safeguarding
 - Point-based sensors
 - No time-series based observations

Re-Imagine Flood Gauge Signage The "Make Over" (Proof-of-Concept, Demo 1)







Integrating Sensing & 2D Modeling The "Make Over"





Integrating Sensing & Mapping Mapping Interface (DRAFT)





Next Steps

- → <u>Execute</u> Pilot Gauge Network
- → <u>Test</u> with Real Storm Events
- → <u>Evaluate</u> Seasonal Effects
- → Evaluate O&M Costs
- → <u>Optimize</u> Performance
- Diversify sensor types
- → Polish Mapping Interface
- → Integrate 2D Modeling
- → <u>Apply</u> Forecasting Methods





Legitimate Trends in FWS

- → Accelerated Real-Time (Machine Learning)
- Global standardization of hydrologic time series data ("WaterML", HydroDatabase)
- → USGS providing open data access.
- → NOAA Big Data Project with AWS
- → IoT Based Technologies
- → Real-time water quality monitoring!



usatoday



Take Home Message

- → FWS can be as sophisticated as you need (no silver bullet).
- Technology is not the limiter
- → No FWS is going to be 100% accurate. Better to be less wrong more often than the opposite
- → Multiple Lines of "<u>Senso</u>r" Defense



→ Keep it simple stupid (KISS)





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Questions? Thank you!

"With poor assumptions, an engineer can make more mistakes with a computer in a millisecond, than with a lifetime of common sense."

~ Quote for Modelers, (author unknown)

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