2026 ARISE Annual Symposium Poster Abstracts

(Alphabetical order by first name)

Equity-Aware Load Prioritization and Planning Strategies to Improve Power System Resilience During HILF Events

Adithya Melagoda and Visvakumar Aravinthan
aumelagoda@shockers.wichita.edu

Power systems and other interdependent infrastructures are increasingly exposed to high impact low frequency (HILF) events, which can cause severe generation inadequacy and load curtailments that disproportionately affect vulnerable populations. To address this challenge, this work proposes an equity-aware optimal restoration and planning strategy applicable to any power network during an HILF event. First, a load prioritization framework is developed that incorporates customer criticality and social equity. The framework first allocates power to critical loads and non-critical loads are ranked using their economic value, social equity and load criticality. Secondly, an equity-oriented optimal switch placement framework is proposed as a long-term planning strategy to reduce disparities in post-event distribution system restoration across vulnerable communities.

Libraries as Resilience Infrastructure: Reducing Heat-Related Mortality Across U.S. Counties

Ali Khaleghinia and Rachel Krause
a.khaleghinia@ku.edu

Extreme heat is the deadliest weather-related hazard in the United States, and vulnerability to extreme heat is amplified by physical infirmity, social inequality, and characteristics of the built environment. In the U.S., elderly, homeless, and Black populations are among those most at risk of heat-related mortality. U.S. municipalities often utilize short-term, formally designated cooling centers as interventions to mitigate risk, but these facilities can be difficult to access and are often underused. This study evaluates whether public libraries, free, familiar, climate-controlled spaces with predictable hours, function as everyday “cooling infrastructure” that reduces heat-related mortality. We assemble a national county-level panel covering 3,009 U.S. counties from 2018–2023 (17,918 county–year observations), linking heat deaths from

CDC WONDER with facility-level Public Libraries Survey data. We operationalize library availability as total library square footage multiplied by annual operating hours, aggregated to the county, and estimate a correlated random effects model, controlling for demographic vulnerability, socioeconomic capacity, political context, and annual extreme-heat exposure. Results indicate that greater library availability is significantly associated with fewer heat-related deaths. Substantively, increasing library availability by the equivalent of keeping 100,000 square feet open for an additional 1,000 hours annually is associated with approximately 35.5 fewer heat deaths per year nationwide, about a 3.7% reduction relative to the 2018–2023 annual average. Taken together, the findings support framing public libraries as scalable heat-adaptation assets and highlight operational levers through which local and state policy can strengthen heat adaptation while reducing reliance on ad hoc emergency measures.

SWMM-TK: Bridging the Data Gap in Urban Flood Modeling through Automated Stormwater Network Generation

Alireza Monavarian, Rahul Madbhavi, Bala Natarajan, and Vaishali Sharda
alirezam@ksu.edu

Urban flooding is steadily increasing due to climate change. While the Storm Water Management Model (SWMM) is a critical tool used for simulating rainfall-runoff and stormwater drainage systems in urban areas, its application relies heavily on detailed infrastructure data. Currently, the widespread lack of stormwater infrastructure data is a major barrier to effectively studying the impacts of varying rainfall across a region.

To overcome this data limitation, we introduce SWMM-TK, a synthetic methodology that automates watershed delineation and stormwater drainage network creation using publicly available datasets, such as Digital Elevation Models (DEM) and road networks. By automatically processing the DEM and aligning the generated primary network with local street layouts, the toolkit mirrors real-world systems. The resulting framework can then be imported directly into SWMM for comprehensive runoff and flooding simulation.

Current development focuses on verifying these synthetic networks using real-world data from urban and rural environments and enriching the model to produce fully executable EPA-SWMM files. Ultimately, SWMM-TK will empower researchers and planners to identify flood-prone areas and perform rapid, large-scale scenario analyses. Future developments will focus on integrating the toolkit with a co-simulator to study the complex interdependencies between various critical infrastructure systems.

Lightweight Neural Network Distillation for Real-Time CAN Bus Intrusion Detection in Vehicles

Amirmasoud Pourmiri, Ali Eslami, Sergio Salinas Monroy

The Controller Area Network (CAN) bus is widely used for communication between vehicle components but has no built-in encryption or authentication. This makes it easy for attackers to carry out spoofing or denial-of-service attacks. In this paper, we present a lightweight Intrusion Detection System (IDS) that can run on a small Electronic Control Unit (ECU) built with a Raspberry Pi. Our system listens to CAN traffic and classifies frames using machine learning models such as Convolutional Neural Networks (CNN), Artificial Neural Networks (ANN), and Long Short-Term Memory (LSTM). The models are trained on labeled datasets stored in HDF format for efficiency. To make the models easier to understand and deploy, they are converted into decision trees using the Trustee framework and run in C++ for real-time use. Tests on a simulated CAN bus with Arduino boards show that the IDS can detect attacks with high accuracy: 93LSTM, and overall more than 99.9using only 0.5Source code is available at: ://github.com/AmirmasoudPourmiri/Resource-Constrained-Machine-Learning-BasedIntrusion-Detection-for-CAN-Communication.

Robust Building Damage Detection in Cross-Disaster Settings Using Domain Adaptation

Asmae Mouradi and Shruti Kshirsagar

axpourmiri@shockers.wichita.edu

Rapid structural damage assessment from remote sensing imagery is essential for timely disaster response. Within human–machine systems (HMS) for disaster management, automated damage detection provides decision-makers with actionable situational awareness. However, models trained on multidisaster benchmarks often underperform in unseen geographic regions due to domain shift—a distributional mismatch between training and deployment data that undermines human trust in automated assessments. We explore a two-stage ensemble approach using supervised domain adaptation (SDA) for building damage classification across four severity classes. The pipeline adapts the xView2 first-place method to the Ida-BD dataset using SDA and systematically investigates the effect of individual augmentation components on classification performance. Comprehensive ablation experiments on the unseen Ida-BD test split demonstrate that SDA is indispensable: removing it causes damage

detection to fail entirely. Our pipeline achieves the most robust performance using SDA with unsharp-enhanced RGB input, attaining a Macro-F1 of 0.5552. These results underscore the critical role of domain adaptation in building trustworthy automated damage assessment modules for HMS-integrated disaster response.

Rain, Resources, and Resilience: Rethinking Stormwater Funding Across the Great Plains

Doug Peterson and Jason Bergtold

dmp052205@ksu.edu

Our project seeks to catalog innovative and existing funding opportunities and pathways for government organizations, businesses, conservation districts, and individuals to fund stormwater infrastructure projects across the Great Plains. We have compiled a database of funding opportunities and types of funding that is housed on Great Plains Stormwater Center for Excellence website (https://gpstormwater.org/). This website will provide financial resources such as grant, loan, cost-share, and rebate opportunities for stormwater infrastructure investments, tools estimating the benefits and costs for stormwater infrastructure and information on innovative funding sources when completed. This information is crucial for improving stormwater infrastructure and adoption of best management practices.

Embedded Machine Learning for Safer Second-Life Battery Applications

Eric Luiz Pereira, Preston Dinh, Davi Soares

r342e598@wichita.edu

Accurate identification of lithium-ion battery chemistries is critical for safe recycling and reuse. In this study, we developed a machine-learning model to classify battery types from voltage profiles. Four supervised models were evaluated under charge, discharge, and full-cycle conditions. The Random Forest model achieved 97% overall accuracy. The model was deployed on a low-cost embedded platform and operated in real time. This work supports resilient and efficient battery recycling systems. By improving chemistry detection, the approach can reduce safety risks, improve material recovery, and strengthen sustainable infrastructure for recycling and second-life applications.

Assessing Urbanization-Driven Land Cover Change and Its Impacts on Ecological Environmental Quality (EEQ) in Rupandehi, Nepal Using Remote Sensing Ecological Index (RSEI)

Gaurav Parajuli, Yogesh Regmi, Abinash Silwal, Bikram Parajuli, Bimal Pokhrel, Aayush Man Karki, Saurav Shrestha, Tridev Acharya

gaurav.parajuli@ku.edu

The evaluation of Eco-Environmental Quality (EEQ) is important to maintain the quality of ecology and is crucial for the protection of the environment and promote sustainable development. In the past 30 years, Rupandehi district has gone into rapid urbanization and population growth due to the migration of people causing drastic changes in Land use. This study takes Rupandehi district as a study area and analyses the land use change dynamics and its impact on the ecological environment from 1993 to 2023. The study utilizes the cloud computing capability of Google Earth Engine (GEE) to extract multiple indices using Landsat remote sensing data. We also applied the Thresholding approach to various spectral indices to extract land use information in GEE. The Remote Sensing Ecological Indices (RSEI) was constructed using Principal Component Analysis (PCA) to monitor the ecological quality and the effect of Land Use Land Cover (LULC) change on the quality of ecology was analysed. The result shows that the overall ecological qualityof the Rupandehi district is good ranging from 0.59 in 1993 to 0.67 in 2023 with a significant impact of land use change. The ecoenvironmental quality of the study area is deteriorating because of a sharp increase in built-up areas and deforestation as well as the loss of agricultural land. Meanwhile, the spatial and temporal distribution of land use change collides with the change in the ecological quality of the study area. This study provides an accurate and rapid assessment of ecological quality and monitors the impact of land use change on it providing a scientific basis for researchers, government, and others to preserve the ecology and promote sustainable and eco-friendly development.

Balancing Short-Term Efficiency and Long-Term Resilience in Municipal Investment Decisions

Grace Atakorah, Rachel Krause, Ali Khaleghinia

grace_email@ku.edu

Heightened climate, cyber, and infrastructure risks force local governments to balance short-term cost efficiency against long-term resilience. Using a national CivicPulse survey of officials from over 670 U.S. local governments, this study measures efficiency preferences (prioritizing least-cost service delivery and reducing operational redundancies) and resilience preferences (willingness to pay upfront for durable assets and maintaining critical backups). Weighted regression models test how fiscal capacity, grant competitiveness, institutionalized mitigation planning, service fragmentation, and recent crisis experience shape these orientations. Results clarify when interjurisdictional competition constrains resilient investment and identify conditions under which resilience is prioritized in contemporary municipal capital decisions.

Wildfire Influences on Agricultural Landscapes: Damages and Perceptions

Jason Bergtold, Marcelus Caldas, Audrey Joslin, Helene Avocat and David Wesseler

bergtold@ksu.edu

In the Southern Great Plains of the U.S., the frequency of large mega wildfire events has increased over recent decades. This shift threatens both livestock and crop production, affecting rural communities and the broader agricultural landscape. Despite these impacts, the region has received less media attention compared to other U.S. regions that are facing wildfire challenges. This study sheds light on the wildfire-induced crop and grazing losses—estimated between $261 million and $512 million from 2008 to 2024—and furthermore examines how wildfire and losses shape the perceptions and responses of agricultural producers in the region. Our findings reveal that perceptions are indeed strongly influenced by megafire events and endure over time, however this awareness does not always translate into proactive mitigation. The proximity and magnitude of wildfires affect producer decisions, but adaptive responses remain inconsistent, especially against megafires. The results highlight the urgent need to prioritize the region in wildfire mitigation and resilience efforts and strengthen coordination in support agricultural production systems.

The Impact of Extreme Weather on Public Transit Service Quality: A Quantitative Analysis of Customer Complaints

Dominic Kyei and Joel Mendez

JMendez2@ku.edu

Extreme weather events in the United States are increasing in both frequency and intensity, creating new challenges for urban mobility and public safety. During such events, public transit can play a critical role by maintaining mobility, enabling access to essential destinations, and providing transportation options for vulnerable populations with limited resources or alternatives. Given these functions, the presence and quality of transit service during severe weather events can be vital for many residents. However, it remains important to evaluate whether transit systems are effectively serving communities when they may be needed most.

This study examines transit performance during hazardous weather events in the Kansas City metropolitan area by analyzing changes in the frequency and nature of transit user complaints. By comparing complaint patterns during severe weather periods with those during typical operating conditions, the research explores whether riders experience a different level of service when weather conditions deteriorate. The findings aim to provide insights into how well transit systems respond to challenging environmental conditions and how rider experiences shift during these events. Ultimately, the study contributes to evaluating the resilience of transit service and identifying potential areas for improvement, helping agencies enhance their ability to deliver reliable and equitable transportation when communities may depend on it most.

Identifying Barriers to Community Safe Room Use Among Manufactured Housing Residents

Madison E. Graham, Brett. W. Gelino, Elaina J. Sutley, Derek D. Reed

madisongraham@ku.edu

Tornadoes disproportionately impact residents of manufactured homes (MH), yet many communities lack accessible safe rooms. We applied an operant behavioral economic framework to identify barriers to community safe room use and estimate the magnitudes at which those barriers deter protective action. In a series of three studies with MH residents from tornado-prone states, participants evaluated sheltering decisions under systematically varying barriers, including walking distance, driving distance, crowdedness, and available space. Results consistently identified accessibility barriers, particularly walking distance, as influential factors in decisions to travel to a community safe room. Additional analyses examined how environmental conditions may further shape sheltering behavior. These findings demonstrate how behavioral economic methods can quantify barriers to protective action and generate evidence relevant to community shelter planning. The results support existing siting guidance emphasizing

short travel distances and highlight the importance of accessibility and communication strategies to improve safe room use among manufactured housing residents.

Wildfire and Severe Drought Effects on Conservation Reserve Program (CRP) Persistence

Mariam Gharib, Jason Bergtold, Helene Avocat, and Marcellus M. Caldas

mhgharib@ksu.edu

The performance of free-standing carbonaceous electrode in organic electrolyte for potassium-ion supercapacitor applications

Md Zawad Hossain and Davi Soares

mxhossain36@shockers.wichita.edu

Artificial intelligence (AI) in manufacturing and agriculture brings a revolutionary change in economic development. Currently, lithium-ion battery (LIB) is the main power source for powering data centers for AI. However, poor power density and sluggish charging are the major challenges for this technology. A potassium-ion supercapacitor (PIS) is a suitable alternative in this case. To increase the power and energy density of PIS and minimize the use of critical minerals (copper and aluminum) for electrode preparation, we are investigating a free-standing carbon-carbon nanotube composite electrode in an organic electrolyte (KPF6 in ethylene carbonate: dimethyl carbonate) in extended potential window.

The Impact of Natural Disasters on Community Capitals at a Local Level

Nick Thompson, Yongwang Ren, Zander Seth, Jason S. Bergtold and Matthew Druffel

nicholas62@ksu.edu

The community capital framework (CCF) is a framework for examining community assets and resources among seven different capitals: natural, cultural, human, social, political, financial and built capitals. We use annual secondary data of various community capital indicators to quantify the impact of natural disasters on community capitals through estimation of impulse response functions (IRFs). We find evidence that human capital, political capital, built capital, and financial capital are impacted by natural disasters. For example, disasters influence employment in art, government spending on

public sector maintenance, number and length of power outages, and personal income. Results provide evidence of linkages between natural disasters and community capitals that can be used for disaster planning.

HABiT: A Hetero-functional Agent-Based Infrastructure Toolkit for Modeling Community Resilience

Niranjana Unnithan, Adaeze Okeukwu-Ogbonnaya, George Amariucai

niranjanaunnithan@ksu.edu

We present HABiT, the Hetero-functional Agent-Based Infrastructure Toolkit, for simulating interdependent power, water, and transportation systems. HABiT models infrastructure as a network of functionalities, such as generating power, transporting water, or consuming vehicles. Each functionality is represented by an autonomous agent with defined behavior, location, and evolving states. The simulation operates over discrete time steps and includes stochastic elements such as random failures, uncertain repair durations, and probabilistic transport availability. We apply HABiT to a simplified model of three communities with different levels of infrastructure access and social vulnerability. The simulation captures both normal operations and disruptions, including recovery influenced by constrained resources, vehicle routing, and mobile repair agents. HABiT uses a hetero-functional graph to represent interdependencies across functionalities. This structure allows components to be added or removed without altering the system configuration, supporting flexible scenario design. Results show that incorporating stochasticity reveals variations in failure cascades and recovery patterns that deterministic models may miss. HABiT enables rapid evaluation of infrastructure disruptions and supports decisions on resource allocation, recovery planning, and resilience analysis under uncertainty.

STRENGTHENING OUR COMMUNITIES THROUGH SMARTER, MORE RESILIENT NETWORKS: A GRAPH LEARNING PROSPECTIVE

Priyanka Gautam and Bala Natarajana

priyankagautam@ksu.edu

BACKGROUND AND PURPOSE: Critical infrastructure systems such as power, water, stormwater, and transportation form tightly interconnected networks vital for essential services and public safety. Failures in one system often cascade, causing widespread disruptions and threatening lifelines such as hospitals and emergency services.

Traditional single-system approaches overlook these interdependencies, dynamic operating conditions, and their broader community impacts. This research aims to develop a scalable framework that addresses dynamic network challenges by identifying critical functionalities, examining causal factors that drive failures, and guiding targeted resilience strategies such as asset hardening and targeted interventions. Our core questions are: Which functionalities and causal drivers most influence community-level resilience, and how can feasible interventions minimize cascading failures and inequities? METHOD: We propose an integrated framework combining Graph Neural Networks (GNNs) and Hetero-Functional Graphs (HFGs). GNNs learn network structure to accurately identify critical nodes and links based on operational data, while HFGs model the interdependencies among community infrastructure systems. To handle changing conditions, we employ dynamic tracking of network status using Wasserstein-based graph embeddings to detect network shifts over time. The technical approach includes GNN architectures for static topology and a dynamic GNN–LSTM model that fuses temporal data with graph structure, enabling real-time, causally informed interventions.

RESULTS/FINDINGS: The results highlight the advantages of learning-based methods, where feature-based metrics and dynamic embeddings capture the richness and complexity of evolving infrastructure networks. The framework achieves 97–99% accuracy in critical node identification and 98–99% for links, with roughly double the prediction speed of simulation methods. HFGs and the dynamic GNN–LSTM further quantify system-level and temporal impacts, providing nuanced insights into cascading failures, their causal drivers, and community consequences. CONCLUSION: This approach is computationally efficient and scalable, supports strategic system hardening and proactive decision-making in large-scale, dynamic infrastructure networks.

Optimal Transport-Based Solar PV Planning for Balancing Grid and Community Objectives

Prudhviraj Dhanapala, Amulya Sreejith, Balasubramaniam Natarajan, and Anil Pahwa

dprdhanapala@ksu.edu

This work presents a constrained optimal transport (COT)-based distributed generation (DG) planning framework that jointly considers power grid operational objectives and community-level priorities. Conventional DG planning methods primarily focus on enhancing grid reliability and efficiency, often relying on aggregate metrics such as average or total consumer costs, thereby overlooking distributional inequities across households. The proposed approach models household energy costs as a distribution

and employs COT to derive a cost-effective transformation toward a target energy burden allocation. The equal-distribution equivalent (EDE) is adopted as a fairness-driven target to systematically guide burden redistribution. By parameterizing the COT formulation, the framework enables systematic exploration of trade-offs between network loss minimization and equitable energy burden allocation. Simulation results on a 559-node distribution system demonstrate that the proposed method significantly reduces high-percentile energy burden and the Gini coefficient while maintaining low active power losses. Furthermore, the approach achieves improved computational efficiency compared to conventional optimal power flow-based methods, highlighting its scalability and suitability for large-scale, community-centric DG planning.

Disproportionate Exposure to Extreme Heat of Households living in Manufactured Housing across United States

Rakibul Islam and Yoonjung Ahn

rakibulislam@ku.edu

Extreme heat poses a severe threat to public health across the United States. It contributes to heat-related illnesses, mortality, and environmental health disparities. Extreme heat exposure is not evenly distributed; therefore, marginalized households often face greater risk. Previous studies suggest that households living in manufactured housing are more likely to be exposed to extreme heat as these homes are often located in areas with higher environmental hazards and socio-economically disadvantageous neighborhoods. This study will examine examines the exposure of households in manufactured housing to heat in compared to households in other housing types in contiguous United States. The analysis is conducted at both census tract and building levels. At the census tract level, extreme heat is measured using the 98th percentile threshold of daily maximum temperature derived from the PRISM NaNDA climate dataset. We apply t-tests and bivariate correlation analysis to compare the exposure of households in manufactured housing with other housing structure types in both renter and owner households. We also incorporate Global Moran's I and bivariate Local Indicators of Spatial Association (LISA) to examine spatial relationships between extreme heat exposure and the share of manufactured housing. At building level, this study uses cumulative distribution functions (CDFs), Gini Coefficient, and regression models with county fixed effects to evaluate heat exposure disparities between manufactured housing units and other buildings while controlling demographic and socioeconomic characteristics. The study finds that households living in manufactured housing types are more likely to be located in areas affected by extreme

heat compared to the households in other housing types across all measures. The study offers valuable insights for policymakers to reduce environmental disparities in housing planning.

HARMONIZING KANSAS LOCAL GOVERNMENT SURVEYS TO STUDY CAPACITY, WORKFORCE, AND INFRASTRUCTURE CHALLENGES

Rory Brennan

rory.brennan@ku.edu

This Community Data Lab project is designed to give students hands-on experience working with real-world public sector survey data related to Kansas local governments. The project centers on harmonizing two complementary survey datasets: an earlier Kansas-only ARISE city survey and a more recent CivicPulse national survey, which includes an oversample of local governments from Kansas. Both surveys examine local government capacity, infrastructure, and service provision; however, some questions differ in wording, structure, and emphasis, making them well suited for a student-led data harmonization and applied analysis project.

IMPROVING TORNADO SHELTER ACCESS IN KANSAS: INTEGRATING HUMAN BEHAVIOR AND INFRASTRUCTURE PLANNING

Saba Faghirnejad, Elaina Sutley, Madison Graham

saba.faghirnejad@ku.edu

Tornadoes threaten lives in communities across Kansas, yet many residents still lack timely and safe access to shelters when warnings are issued. My research focuses on understanding how Kansas households make sheltering decisions and how infrastructure can be planned to reduce injuries and deaths during tornadoes. Using more than 10,000 responses from a survey administered to households across the State of Kansas, I am analyzing factors such as trust in tornado warnings, presence of basements or community shelters, household characteristics, housing type, and examining difference across rural and urban households.

My collaborators and I are combining this survey analysis with simulated tornado scenarios to identify where shelter access is limited, and which groups face the greatest barriers. For example, people who must drive long distances to reach public shelters, residents of multi-family buildings without basements, or residents with specific health or

accessibility needs. By linking human behavior with infrastructure planning, my research reveals patterns in how Kansans respond during tornado emergencies and identifies opportunities to improve access to safe shelter.

The results of this work can guide local governments, emergency managers, and urban planners in identifying shelter locations that maximize safety for the greatest number of people. Ultimately, this research aims to reduce tornado-related casualties by improving how Kansans prepare for and respond to severe weather.

The Current State of Disaster Preparedness of Households Across the Central Great Plains

Samantha Bonifas, Jason S. Bergtold, Madison Graham, Eliyasu Osman, Eliana Sutley

bergtold@ksu.edu

Natural disasters and emergency events can pose significant risks to public safety, critical services, and community support. Understanding how individuals prepare for these events and what services are available is important to improve resilience and support systems. This study examines household disaster preparedness across households in the Central Great Plains. We collected primary survey data across five states (IA, KS, MO, NE, and OK) through Qualtrics examining household disaster preparedness using a comprehensive list of practices and resources households could adopt. Findings show that many households remain unprepared for a disaster event, and many do not have basic supplies.

Mergers and Acquisitions in the Trades Sector in Kansas: Effects on Wages and Employment

Stephen Paolillo, Joshua Lee, William Duncan

spaolillo@ku.edu

Mergers and acquisitions represent large shocks to markets. In this poster we examine how these market concentrating moves can affect the wages and employment in a specific sector, in this case: the trades. We use Kansas as a case study and conduct some descriptive analysis on wages and employment in the sector when there is a merger or acquisition and when there is not.

Severe Winter Storm Experiences and Impacts on Households across the Central Great Plains

Taylor Hooper-Deleon, Jason S. Bergtold, Madison Graham, Eliyasu Osman, Eliana Sutley

tlhooper17@ksu.edu

We investigated the differences between household experiences to ice storms, and extreme winter storms across the Central Great Plains. We co collected primary survey data across five states (IA, KS, MO, NE, and OK) through Qualtrics examining households experiences and responses to weather conditions, damages, outages, inconveniences, and assistance received. Findings from summarizing the data reveal the presence of transportation issues, decreased access to necessary services, a lack of preparedness, and extensive outage durations for power, water, and heat. Our findings reveal the urgency for improving disaster preparedness for households, challenges communities face, and how to better help residents prepare.

Build Your Future: STEM Programming for Youth and Families

Tracey Funk, Teresa MacDonald, Eleanor Gardner

trfunk@ku.edu

Build Your Future engages youth and families in Wyandotte County through programming to explore connections between infrastructure, environment, and well-being. Learn about the KU Natural History Museum's STEM education and outreach programs for youth and their families in partnership with KU's TRIO Talent Search Program hosted at Kansas City Kansas Community College. Chat with us about how you can get involved in future outreach efforts.

Enhancing Cross-Domain Generalization in Building Damage Assessment: Fusion Augmentation and Domain Adaptation for Satellite Imagery Analysis

Unaza Tallal, Shruti Kshirsagar, Bharath Chandra, Rajiv Bagai, and Atri Dutta

y533r777@wichita.edu

Automated building damage assessment from satellite imagery has become increasingly critical for rapid disaster response and humanitarian relief operations. However, current state-of-the-art deep learning models exhibit significant generalization

challenges when deployed to geographically and environmentally diverse regions. This study investigates the nature and extent of geographic bias in building damage detection systems, revealing that model performance degradation stems primarily from geographic and structural characteristics rather than insufficient training data representation. Through systematic evaluation of top-performing xView2 competition solutions across 17 disaster locations spanning multiple climate zones, we found that even state-of-the-art models struggle with generalization, particularly for Minor and Major damage classes, and exhibit strong geographic biases toward certain regions. Strikingly, Nepal despite having the largest training dataset (15,234 images)—achieves the worst performance, demonstrating that geographic and structural characteristics dominate generalization behavior more than training data quantity. To address these fundamental limitations, we explore Fusion Augmentation, a novel methodology that enhances edge detection and structural feature representation by integrating auxiliary information channels with standard RGB imagery. Experimental results demonstrate substantial improvements of 7.1% overall F1 score, with dramatic gains for intermediate damage categories such as Minor and Major damage. Domain adaptation experiments on three unseen locations show that combining Fusion Augmentation with supervised fine-tuning yields 40.8% and 60.0% improvements over Minor and major classes, while unsupervised CORAL achieves 24.2% and 39.5% improvements over Minor and major damage classes compared to benchmarks. These findings challenge prevailing assumptions about data-driven generalization in remote sensing AI systems and demonstrate that structural feature enhancement combined with domain adaptation is essential for robust detection across geographically diverse deployment scenarios, providing practical strategies for globally deployable damage assessment systems.

Cognitive Silicon: Synergizing Reasoning-Enhanced LLMs and PPA-Oriented Reinforcement Learning for Resilient and Secure Hardware Infrastructure

Weimin Fu and Dr. Xiaolong Guo

weiminf@ksu.edu

The automation of hardware design via Large Language Models (LLMs) faces two critical bottlenecks: the "hallucination of functionality," where generated designs fail to meet strict semantic constraints, and "physical blindness," where syntactically correct code violates Power, Performance, and Area (PPA) requirements. This work presents a unified "Cognitive Silicon" framework that bridges these gaps through two novel methodologies. First, we introduce Function-Aligned Differentiated Revision (FADR), a reasoning-enhanced generation method that enforces a structured "Chain-of-Thought"

planning phase, improving functional correctness (Pass@1) by 20% and eliminating logic bugs that often serve as security vulnerabilities. Second, we propose the PPA-RTL framework, which utilizes Reinforcement Learning (RL) with offline reward modeling to explicitly optimize post-synthesis metrics. This approach reduces power consumption by ~21% and area by ~29% without human intervention. By synergizing semantic reasoning with physical optimization, this framework addresses dual critical needs: it hardens the hardware supply chain against implementation flaws and enables the democratization of energy-efficient, custom sensor design for community resilience.

Modeling Community Wellbeing through the Community Capital Framework: A Structural Modeling Approach

Yongwang Ren and Jason Bergtold

yongwang@ksu.edu

We propose a modelling framework that integrates all 7 community capitals, interactions between the capitals, and influence of capitals on community vitality and wellbeing. The framework would also include the ability to model shocks to the system from natural disasters. We have already built a large panel dataset of capital indicators and community wellbeing measures at county-year level for model estimation. Using this data, we are developing an econometric approach to modeling capitals as a dynamic system that incorporates shocks from disasters over time. A structural equation modelling (SEM) approach will be used to estimate direct and indirect influences of different capitals on community vitality and wellbeing while considering the interactions or interdependencies between capitals that also incorporate natural disaster events to examine their influence and how they perpetuate through the system.

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