Disaster and Recovery Informatics

Objectives

- Archive data generated before, during, and after events according to accepted standards
- Provide open access to data for researchers, public officials, and the public to improve decision-making
- Fuse data of different types from many distributed sources
- Provide tools and decision support systems to help decision makers and the public understand and use data
- Help organizations adapt to new decision support systems
- Couple data with appropriate analysis to support prediction, warning, mitigation, and communication
- Assure security and confidentiality to facilitate data sharing

Technological Challenges

- Develop standards for disaster data and metadata to facilitate interoperability, data mining, and analysis
- Create translational community templates to enable multi-sourced data collection and sharing
- Create analytical approaches to characterize and employ locally, organically generated data irrespective of form
- Create highly diverse sensor systems with novel sensing modalities that are low-cost, rugged, and durable
- Create automated decision support tools to generate actionable information for decision makers and the public
- Design/modify disaster management organizations' decision-making processes to use new data and tools

Broader Impacts

- Greater public safety and more stable societies
- Better ability to employ data reduces uncertainty, improves consistency in decisions and actions, and allows more decisions to be made pre-event
- More sensors, higher-fidelity models, and greater predictive capabilities allows quicker reaction to disaster events and more effective prioritization during events
- Seamless data sharing improves the speed and quality of decisions, and offers the potential for new insights

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Open access to archive data generated before, during, and after events according to accepted standards will improve decision making and priority setting with respect to hazard mitigation, preparedness and response. This requires fusion of disparate data types originating from multiple distributed sources coupled with automated tools and decision support systems to help decision makers and the public to understand and use data. Furthermore, translational community templates will enable multi-sourced data collection and sharing. The result is enhancement of the decision-making and public communities' ability to employ data to reduce uncertainty, improve consistency in their decisions and actions, and make more decisions pre-event.

Anticipatory Expert Learning

Objectives

- Improve ability to learn from past experiences, take advantage of lessons, and prevent repetition of mistakes
- Create learning systems and technologies that translate lessons from one context to another
- Account for regional and cultural differences
- Improve ability to anticipate and make appropriate decisions ahead of disasters
- Understand underlying causal processes in success and failure in event assessment and recovery
- Develop scenarios based on assessment of local conditions and use them as testing and evaluation tools

Technological Challenges

- Employ social networking data streams for data collection and feedback mechanisms to support systemic learning
- Develop quantifiable models that track and predict social reaction to disasters and social behavior after disasters
- Conduct meta-analysis of past case studies to gain new insights and identify lessons that need to be learned
- Employ decision science to understand when and why we fail to learn from past experience and to develop transformative approaches to learning
- Develop effective, credible, understandable, and useable translational dissemination methods, including specific guidelines and guidebooks for communities

Broader Impacts

- Taking full advantage of collective experience leads to more effective disaster management
- Disasters employed as opportunities to improve on pre-disaster environments and create societal resiliency
- Reduction of false alarms leads to greater public trust in decision makers
- Allows use of past disaster experience to better prioritize investments and limited resources
- Individual-level data for whole networks allows better understanding of how people and communities react in the fact of disaster

Anticipatory Expert Learning

To improve the performance of disaster management systems and to enhance anticipatory decision making, we must be able to learn from past experiences, take advantage of lessons, and prevent repetition of mistakes. To accomplish this goal, social networking data streams can be employed for data collection and may serve as a feedback mechanism to support systematic learning. In addition, meta-analysis of past case studies can yield new insights and be incorporated into new translational dissemination methods. Finally, decision science should be employed to understand when and why we fail to learn from past experience and to develop transformative approaches to learning.

Systems-based Infrastructure Management

Objectives

- Systems perspectives on infrastructure building standards to prevent cascading failures
- Integrated structural health monitoring, hazard forecasting, and public warning systems
- Codes and enforcement for community wide resilience
- Better characterization of hazards to improve construction, retrofit, and reconstruction and set priorities
- Understand and overcome political, legal, educational and financial challenges to new technology adoption
- Automated warning systems coupled with robust and credible public communication systems

Technological Challenges

- Develop research platform to integrate multiple disciplinary perspectives to design resilient infrastructure for all hazards
- Integrate sensor data with simulation tools to support pre-event prediction, early warning, and post-event assessment
- Technologists and social scientists collaborate to develop regional and culturally sensitive warning systems
- Model interdependencies among infrastructure systems to identify weaknesses, set mitigation priorities, and facilitate multi-disciplinary collaboration to solve problems
- Establish standards, set priorities, and develop cost-effective methods for the design and retrofit of sustainable structures
- Improve the modeling of infrastructure to account for human impacts of failure

Broader Impacts

- Safer and more sustainable infrastructure with reduced loss of life and less property damage
- Better understanding of potential losses and the long-term, broader consequences of those losses
- Ability to make smarter and more-cost effective preparedness decisions
- A macro-view of infrastructure importance, vulnerability, and conditions to inform mitigation priorities
- Understanding of the relationship between people and infrastructure to inform preparedness priorities, design of warning systems, and predict recovery outcomes

Systems-based Infrastructure Management

A systems perspective on infrastructure building standards is required to prevent cascading failures during disasters. Towards this end, diverse, multi-modal sensor data must be seamlessly integrated with simulation tools to support pre-event prediction, early warning, and post-event assessment. In addition, interdependencies among infrastructure systems must be modeled to identify weaknesses, set mitigation priorities, and facilitate multi-disciplinary collaboration to solve problems. This will lead to safer and more sustainable infrastructure with reduced loss of life and less property damage.

Resolutions

Create an independent, multidisciplinary, international task force to establish an open standard for the structure, content, storage, security, use and interoperability of disaster data. Furthermore, NSF-NSC (with the assistance of other federal agencies) should prioritize funding for the archiving of disaster data for open access.

NSF and NSC should fund fundamental research aimed at improving long-term sensor reliability in the field, the engineering of new, non-traditional sensor types, and the development of new organizational decision making systems that use these data for prediction and post-event assessment. Furthermore, prioritize the exploration of social modeling and social network data collection.

Fund an on-going process of review and meta-analysis of past case studies to establish baselines, gain new insights, and learn unlearnt lessons. Extract common lessons and promote organizational systems that use the lessons learnt to advance the state of the art in disaster management. Furthermore, ask the National Academies to study the phenomena of why we have not learnt lessons effectively from past disasters to improve future organizational learning systems.