NETWORK TRAFFIC MANAGEMENT UNDER DISASTER CONDITIONS

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NU AFFILIATION

- **MS Degree**
  Airport Access Mode Choice Modeling
  (Advisor: Prof. Frank KOPPELMAN)

- **PhD Degree**
  Network Traffic Management under Disaster Conditions
  (Advisor: Prof. Athanasios ZILIASKOPOULOS)
Very difficult for a typical engineer
  - Even for traffic engineers

Depends on the disaster type
  - No-notice events versus others
  - Man-made versus natural ones
  - Local issues (social, cultural, economic, modal availabilities, network differences, etc.)
  - Personal/psychological issues (family integration, pets, etc.)
Define Subproblems
- Evacuation
- Emergency response
- Logistic operations
- ..

Timeline
- Preparedness and Mitigation Plans
- Disaster Response
- Recovery and Evaluations
- Preparedness ...

DISASTER TRAFFIC MANAGEMENT
Personal Motivation:

- 1998 - MS Degree
  → looking for a PhD topic
- 1999 Devastating Earthquake in Turkey
  → more than 30000 fatalities;
  → major problem in managing traffic
  → during the S&R process
- Research Question: why not to reverse some road to ease the evacuation of the cities?
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- Literature Review:
  - 1970s → chemical spill in a river
  - 1979 → Three Mile Island accident - partial meltdown at a nuclear power plant → evacuation planning for nuclear power plants
  - 1990s → FEMA’s attention to hurricane evacuations
Literature Review:

- 1970s → chemical spill in a river
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- 1990s → FEMA’s attention to hurricane evacuations
- 1999 → my interest in the topic
  → National Hurricane Conference
  → ETIS model
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- Literature Review: Keywords
  - Disaster (hurricane) forecasting;
  - Travel demand forecasting;
  - Compliance with evacuation order;
  - Congestions in the network;
  - Estimation of evacuation time and routes;
  - Disaster zones:
    - Cold, warm, hot
**Literature Review: Keywords**

- **Planning models**
  - Not much real-time data and dynamic analysis
  - Not much operational value

- **Capacity reversibility/contraflow**
  - For hurricanes mostly;
  - Considered in disaster management plans but not employed due to possible implementation problems and legal issues → needs a network traffic management approach!!
Literature Review:
- 1999 → my interest in the topic
- 9/11, 2001 → terrorist attacks
  - man-made disasters,
  - homeland security and traffic management
  - Potential disaster risks beyond naturally disaster-prone areas
- 2005s → received my PhD degree
  - SO-traffic assignment principle
  - DTA model
  - Contraflow (supply management)
  - Demand mobilization (demand management)
Gap: Travel demand behavior; compliance with evacuation orders
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- Literature Review: Keywords
  - Evacuation time estimation
    - Route choice
    - Contraflow
    - Queue formations at the beginning and end of contraflow corridors

- Research Gap
  - Travel demand behavior
    - go beyond 3 S-curves
    - Intra-zone mobility for family integration before evacuation
    - compliance with evacuation order time, routes or destinations
DISASTER NETWORK TRAFFIC

- Literature Review: Keywords
  - Evacuation time estimation
    - Route choice
    - Contraflow
    - Queue formations at the beginning and end of contraflow corridors

- Research Gap
  - Travel demand behavior
  - Large network models
  - Real-time congestion management (people with cars)
  - Multimodal evacuation planning (people without cars)
Literature Review:

- 2005 → Hurricane Katrina
  - Problems with evacuation of non-car users
- 2010s → more sophisticated evacuation network management models
  - Bi-level programming models
  - Downtown evacuation models
  - Multi-modal evacuation models

- But, still very primitive in terms of operational requirements
- Needs more input from travel behavior modeling and real-time network traffic management tools
A new dimension:
- 2010 → invited to a PhD jury in Turkish Military Academy on evacuation after CBRN
  - Network optimization + contamination problems
  - Triage
  - Location choice of decontamination units
  - Vehicle routing in/out of or around disaster zone
  - Evacuation of military units
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- What if a CBRN attack on a civil/urban location happens?
Thank you for listening ....