





C entre for ire Safety Engineering

Introduction to FireGrid

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The Dalmarnock Fire Tests: Experiments & Modelling

Wednesday 17 November 2007 The Royal Museum Lecture Theatre



Contents



Vision of FireGrid



- Facilitate transformed emergency response
- Via information on incident evolution
 - Real time status
 - Prediction of future hazard
- Innovative simulation tools
 - Grid-enabled
 - Sensor-linked
- Command and control
 - Intelligent systems for end users

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School of Engineering and Electronics									
NEWS	FireGrid	FireGrid Cluster Re	for Next Ger esponse Sys	neration Emerg tems	ency				
Home									
Members	Our mission is to establish a cross-disciplinary collaborative community to pursue fundamental research for developing real time emergency response systems, using the <u>Grid</u> , beginning with fire emergencies.								
Meetings	The challenges are:								
Publications	 Sensing: Data collect 	tion from the emergency location with	n instantaneous and cont	inuous relay to the emergenc	v response				
Presentations	system (involving a large array of sensors communicating with each other as a network and with the response system via Grid);								
Projects	 Modelling: Simulatio (and therefore predict 	on tools running in a predictive mode t the collapse), while also analysing th	o model the evolution of the intervention alternative	the fire, establish its impact o s and evacuation strategies;	in the structure				
Links	• Forecast: All simulat	ions, analyses and communications t	to be achieved faster that	n the evolution of the emerger	ncy in real time;				
Contact	 Feedback: Processing of the continuously updated sensor and simulation data relayed back to the active response systems at the emergency location and to the emergency services to assist their intervention; 								
	 Response: Effective of aid. 	co-ordination of all intervention by a c	ommand and control sys	tem using an intelligent exect	ution support				

NEWS & EVENTS: DTI FireGrid Project is ongoing

Model integration & grid FireGrid

Simulation tools for

- Fire development
- Human behaviour
- Structural response

Provide support for

- Early fire detection
- Guiding egress
- Hazard prediction, including collapse





(a) Weak floors buckle

Stiff floors provide sufficient reaction

Current limitations

FireGrid

- Disparate technologies
 - Hardware and software
- Not fast enough!
 - Particularly advanced simulation tools

• Require

- Holistic approaches
 - Hierarchical
 - Redundancy
- Grid enablement
- Sensor-linking





Grid/HPC



• Grid

Dynamic discovery and co-ordination of distributed computing resoruces

• HPC

- High performance computing
- Parallel processing

• Issues

- On-demand access
 - Priority scheduling, escalation
- Security
 - Authentication and authorisation





Dalmarnock experience



• A-priori simulation

- A big challenge
- Wide scatter in predictions

• A-posteriori simulations

- Also challenging!
- Complexity of fire phenomena
 - Multi-fuel
 - Wind effects
 - Random aspects

Model "steering" via sensors





Sensor linking



- Key innovation
- Potentially overcomes model limitations
 - Even the most sophisticated simulation tools
- Challenge in implementation
 - Integrating two complex representations of reality
 - Modelled state
 - Measured state
 - Significant uncertainty in both
 - Data assimilation



Sensor linking







Data assimilation



MODELLED STATE

Simulation tool:

• limited understanding

• numerical errors

MEASURED STATE

Sensors readings:

- experimental errors
 - indirect & patchy

FUSION

Completeness v Speed

Completeness v Cost

ANALYSIS STATE

Forecasts capability:

- lead time
- confidence limits





Sensor networks

- System requires
 - Large numbers of sensors
 - Large buildings
 - Frequent updates
 - Early detection
 - => Significant burden on communication protocols
- Wireless networks
 - Redundancies
 - Self-organising



Dalmarnock experience



- Large volumes of data logged
 - 25GB of results
 - Dominated by video records
 - Data storage and access via grid

Instrumentation development

- Wireless sensors
 - Data reduction
 - Attenuation





Command and control



• Scope

- Automated responses
- Human decision makers
- C3I (Command, control, communications & intelligence)
- Draws upon AI concepts
 - Knowledge-based
 - Planning techniques
 - Requires support layers
 - Abstract raw data
 - Interpret simulation results

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Dalmarnock experience



• Control

- Fire Test Two "controlled fire"
 - Early intervention successful
 - Assist fire fighting

Command

- Human decision-makers quickly overwhelmed
 - Understanding current conditions
 - Making predictions
- Assists assessment of information provision to end user



Conclusions



- FireGrid provides a strategy
 - Equipping emergency responders
- Dalmarnock experience
 - Sensor-linked simulation tools
 - Integrated models
 - Grid enablement
 - Intelligent decision-making







Technology integrations



