Overview of EDA projects MODITIC and CENSIT

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Norwegian Defence Research Establishment (FFI)

- Established 1946
- Major defence R&D organisation in Norway
  - Serving all Ministries and governmental bodies, as well as other Norwegian and European stakeholders
- Six divisions

- **Protection and Societal Protection Division** includes i.a.:
  - CBRN threat and consequence assessments
  - Preventive, protective and recovery measures
  - Flow physics

- **Air and Space Systems Division** includes i.a.:
  - Satellites and space
  - Multi- and hyperspectral imaging
  - IR detector technology
MODITIC - MOdelling the DIspersion of Toxic Industrial Chemicals in urban environments
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MOdelling the DIspersion of Toxic Industrial Chemicals in Urban Environments

• European Defence Agency (EDA) category B project

• Lead by FFI

• Contributing member states (cMS):
  – Norway (FFI),
  – Sweden (FOI),
  – France (DGA NRBC Maitrise and INERIS)

• Subcontractor FFI: University of Surrey, UK

• Duration: 01.09.2012 – 01.03.2016
Objectives and project content

- Systematically study the release and transport of neutral and non-neutral chemicals in complex urban environments
- Enhance our understanding of the dominating physical processes involved
- Support improvements in modelling techniques
  - Wind tunnel experiments
  - Numerical simulations
  - Field and source term experiments and computations
  - Linear inverse modelling
  - High-quality database
Geometries and release scenarios of increasing complexity

Flat surface
Two-dimensional hill
Two-dimensional back-step

Simple array of obstacles
Complex array of obstacles
An urban area – central Paris
Paris, neutral gas release
Paris, dense gas release

Wind direction

Source
Main results and conclusions (1)

• Large database
  – Experimental results for release and dispersion of neutral and dense gases in complex geometries
  – Quality assurance is ongoing (feedback between experimentalist and modellers)
  – Subsequently it will be made available

• Operational models
  – Models are usually conservative and overestimate the concentration levels close to the source
  – Of the models tested, just one of the models was able to handle both obstacles and dense gas dispersion

• RANS simulations
  – Models used can capture the turbulent transport of neutral releases
  – Buoyant effects are only partially captured
Main results and conclusions (2)

• LES simulations
  – The LES methodology used is suitable to predict both dense and neutrally buoyant releases of gas within an urban environment
  – Care should be taken concerning the inflow conditions with regard to the spatial and temporal resolution of the incoming boundary layer
  – Care should be taken to resolve the source details

• Inverse dispersion modelling
  – Inverse methods work acceptably well in the urban setting with neutral releases
  – A greater challenge is the treatment of dense gas emissions

• MODITIC website: www.ffi.no/moditic
  – Reports and papers
Fusion of CBRN sENSor Information in Tactical networks - CENSIT
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• Joint Investment Programme (JIP) CBRN protection
• Start: March 2015
• Duration: 30 months
• Finish: December 2017 (Extended with 3 months)
• Partners
  – FFI: Norwegian Defence Research Establishment (lead)
  – TNO: The Netherlands Organisation for Applied Scientific Research
  – ITTI Sp. z.o.o.: Poland (SME)
  – TMS: Technical Mathematische Studiengesellschaft, Germany (SME)
Background for CENSIT Project

• Early detection, warning, and reporting after a CBRN incident is paramount in order to safeguard the life and health of the personnel and to sustain operational capability
• This requires building robust situational awareness in near real-time
• It is generally believed that a robustly networked force improves information sharing, giving enhanced situational awareness. This, in turn, enhances sustainability and speed of command (net-centric warfare)
• Today’s warning system for CBRN incidents is often based on voice messages. Lessons identified from exercises show that this often leads to poor situational awareness
Aim of CENSIT

Develop a conceptual network of sensors that improves the commander’s situational awareness both in the threat phase and in the response phase of a CBRN incident.

**Target goal:** Earlier and more accurate detection, warning, and reporting through fusion of CBRN sensor information in tactical networks.
Acquiring Perception

The best decisions are made with the best and most accurate data

Data acquisition:
• What data do we need?
• How do we obtain the data?
• How do we know that we have all the available data?
• How do we know that the data are correct?
• How much data do we need?
Obtaining Comprehension

- Integration of sensors in C2IS environments allows for obtaining a huge repository of data and information about the environment.
- Providing as much data and information as possible is not necessarily an adequate way to support the decision-maker.
- Most of the data can, however, be seen as distracters and noise.
- Sensors may give a large number of false positives.
- It is hypothesized that fusion of CBRN sensor information will lead to earlier and more accurate detection, warning, and reporting.
Concept for Deployment

• State-of-the-art strategies for sensor deployment around a military camp have been depicted and compared
• A genetic algorithm approach gives the best balance between performance and computational cost
• A software tool for optimizing the deployment of sensors has been developed in Censit
Concept for Sensor Data Fusion

- A Sensor & Background Model has been constructed
  - Sensor Response Model for selected sensors & agents
  - Sensor Response Distribution including „background only“ for defined scenarios
  - Time series of sensor response

- Clutter-learning
  - Deployed sensors could monitor clutter when no threat agent is present and use this to learn the clutter characteristics
  - This is used to reduce the false alarm rate
Situational Awareness

• This work-package is still ongoing.
• It is hypothesized that fusion of CBRN sensor information will lead to better situational awareness.
• The added value of networked sensors compared to stand-alone sensors will be demonstrated.
• The situational awareness could also be enhanced by clutter learning when no threat agent is present.
• The challenge is the small number of sensors that will be affected by a chemical release.
• Space-based sensors might be used to complement point-sensors on the ground.
Overview

Overall objectives:
• Explore what improved operational performance is possible to achieve by fusion of sensor information in tactical networks in order to enhance the CBRN situational awareness
• Explore how networks of sensors can be constructed by development of concepts for sensor data fusion and development of concepts for deployment of sensors

Outcome:
• Demonstration of a prototype system of a simulated network of sensors at the desktop level
• The added value will be evaluated and compared to a system of equal, but not-networked sensors