Use of a Synthetic Environment to Support Acquisition

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Introduction

• There is a growing use of synthetic environments to augment laboratory and field experiments that support the acquisition of improved military capability

• The synthetic environments can be used in several ways
  – To make the initial business case for a new acquisition program or to identify new lines of development
  – To shape the research program
  – To test and evaluate equipment

• Dstl’s Virtual Battlespace has been used to support the acquisition program in areas including
  – Biological area detection
  – Low-burden protective clothing
What is the Virtual Battlespace?

- A synthetic environment including (some under development)
  - State-of-the-art dispersion models (UDM & SCIPUFF)
  - Models of CBR defence system (detection, protection, MCMs)
  - Representation of movement of entities (aircraft, army units)
  - Links to combat & facility models (WISE, OneSAF, STAFFS)
  - Multiple run controller
  - Wargaming mode
The Virtual Battlespace Models

- Dispersion Modelling
  - CBR sources and hazard plumes (weapons, IEDs, RDDs, TICs & TIMs)
  - Urban and Rural (SCIPuff & UDM)
  - Concentration Realisation

- Meteorology
  - Terrain
  - Local Wind Turbulence
  - Sea Breeze

- Military Units/Personnel
  - Effects (casualties)
  - Inhalation & Contact Hazard (liquid pickup)
  - Medical Countermeasures
  - IPE
  - Physiological Burden
  - Aggregation
  - Value of Information

- Detectors
  - Simple (threshold)
  - Generic
  - Specific
  - Standoff
  - Biological Background
  - Single & Network Alarms

- Modes of Use
  - Wargaming
  - Assessment

User Interface
Multiple Run Controller and Data Analyser
Modelling Framework
Geographical & Environmental Data
CBRN Static Data
Model X
Model Y
Model Z

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Biological Area Detection

- Previous work on acquiring the Integrated Sensor Management System
- Now a soft OA workshop study will define the concepts of use for an area detection capability
- This will quantify capability provided by networks of generic, specific and stand-off detectors in the CBVB
- Two main aims of the work:
  - Guide the research programme by estimating the performance of current and planned detectors
  - Allow stakeholders to make informed decisions by demonstrating what is and isn’t feasible
Integrated Sensor Management System (ISMS)

• Dstl supported the Defence Procurement Agency’s assessment of systems developed by industry
  – Field trials expensive; detectors not available

• Therefore the assessment carried out in the Virtual Battlespace
  – Realistic simulation of biological background & turbulent, meandering plumes
Modelling

- **Meander turbulence model** linked with UDM to provide a simulation of meandering plumes
  - required for realistic stimulation of detectors etc.
- **Biological background model** developed
  - based on field data
- **Generic biological detector models** developed
  - include measurement noise and sampling noise
Outcome

- Successful study
  - Scored systems objectively
  - Guided number of sensors required
  - Assessed performance in difficult environments (rural, urban)
Sensor Networking

- Last year looked at networking WIBS1 sensors using GARCH
- WIBS1 network not sensitive enough but GARCH improved performance
- Plan to extend to other sensors and evaluate new and existing network fusion algorithms in the CBVB
Task 1 – Improve ISMS Network Fusion

- ISMS uses the Biral VeroTect generic sensor & very simple network fusion algorithms
- GARCH network fusion algorithm shown to be effective on WIBS1
- Compare effectiveness of ISMS algorithm and GARCH against model of VeroTect
- Results to feed into ISMS incremental update in March ‘07
Task 2 – Find Optimal Generic Detector

- Lots of different generic detector prototypes
- How much size, shape and fluorescence information before we approach maximum performance of a generic detector?
Task 2 – Find Optimal Generic Detector

- Size information important
- Fluorescence spectra contain 2-3 pieces of information
- Bulk fluorescence offers little discrimination – need fluorescence on a particle basis
- Crude shape information required (liquid spheres)
Aircraft & Aircrew CBRN Survive To Operate

• A large programme to procure CBR protective equipment for aircraft & aircrew

• OA used to determine
  – Is AACSTO necessary?
  – What air capability does AACSTO need to maintain?
  – What hazard levels are involved in air operations?
  – What is the burden of AACSTO on aircrew?
AACSTO – Phase 1 - 3

• Phase 1 - Complete
  – Review of existing work undertaken across MOD
  – Concluded that no work tested against comparable threats to those currently faced

• Phase 2 - Ongoing
  – Identify threat scenarios and use of CBRN materials
  – Determine the aircraft involved in these operations and their corresponding missions
  – Identify the concepts & doctrine used to mitigate the use of CBRN

• Phase 3 - Ongoing
  – Series of war-games and workshops to determine the areas in which AACSTO is most necessary
AACSTO - Phase 4

• Two main goals:
  – Quantify the CBR challenge that aircraft and aircrew may be exposed to
  – Determine the thermal load placed upon aircrew and ground-crew by a range of protective ensembles

• We use the aircraft, missions and threat scenarios that are coming out of Phase 2 (running in parallel)
The CBR Virtual Battlespace (CBVB)

- The CBVB is used for the modelling in Phase 4
- New models have been added to the CBVB as part of this work
  - Airframe Model
  - Heat Strain Model
  - Protection Model
  - Radiological Post Processor
Task 1 – Draw up Mission Profiles

- Mission Profiles will include
  - Activity level (Watts)
  - Waypoints that describe route taken (either absolute or offset via velocity and start point \((x,y,z,t)\))
  - Type of clothing represented as a protection factor and thermal and vapour resistances
  - Local environmental conditions, including temperature, winds & stability

- Take into account different phases:
  - Aircrew at rest on airbase
  - Transference to air platform
  - Take off
  - Level flight at representative height
  - Landing
Task 2 – Safe Core Temperature

- Do mission profiles from Task 1 result in safe core temperatures?
- The Heat Strain Model
  - Based on US SCENARIO model, but improved
  - Now passed V&V testing
  - Is being compared against other models
    - USARIEM model
    - DSTO Werner/Lotens model
    - QinetiQ model
  - Also compared against experimental data
Task 2 – Safe Core Temperature

• The Airframe Model
  – Estimates the environmental conditions inside aircraft (radiant and ambient temperature, humidity & wind-speed)
  – Based on lit search of past trial data & simple atmospheric physics
  – Now integrated into the CBVB

• CBVB can calculate the heat strain associated with current and prototype clothing ensembles
  – Drive future clothing research
Task 2 – Safe Core Temperature

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<th>Core Temperature (°C)</th>
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</tbody>
</table>

- Outside Airframe
- Flying to Target
- Engaging Enemy
- Returning to LZ
- Running from LZ Away From Hazard
- Resting
Task 3 – Determine CBR Challenge

• The Protection Model
  – New model to determine the protection factors provided by various types of aircraft now integrated into CBVB

• Predict the CBR hazard to the platforms at various times during the mission profiles:
  – Given that a CBR event is intercepted, determine if a high or low burden protection option is required, and when during the mission it is needed

• Mission profiles from Task 1 against current threat scenarios
  – Use of agent, weapon system and target will be derived from CBR planning scenario development work
  – Meteorological data specific to the location

• Challenge model runs completed for helicopters – fast jet and fixed wing runs underway.
Conclusions

• The Virtual Battlespace has been successfully used to support the acquisition process
  – Used to both test and evaluate existing capability and drive research in new areas
  – Significantly improved capability (includes casualty chain, effects on operations)
  – Widely used (2004-05 – 1 study; 2006-07 – 5 studies)
    • Every study improves VB, benefiting subsequent studies
  – International
    • New TTCP CBR Group AG
    • DSTO involvement