Modeling the Impact of Combat and Influence Actions on Population Attitudes toward Forces

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The Need

- There is a need for integrated computer-aided training of stabilization operations and COIN operations that encompasses also a “population-centric” perspective.

- PsyOps and CIMIC specialists, especially analyst profiles, are looking for more advanced training means, but there is in Europe no available computer-aided training system that would simulate the effect of various PsyOps messages and CIMIC actions on a population.

- A similar need arises regarding decision aid tools for PsyOps and CIMIC situation assessment and planning.
The Need

- In-service brigade-level training simulation systems do not model the impact of kinetic and non-kinetic actions of both Blue Forces and insurgents on attitudes and behaviors of population.

- An integrated computer-aided training solution would span across command staff and specialist levels and allow officers from combat units and from PsyOps and CIMIC units to train together, the latter having a real impact and thus a real stake in computer assisted exercises.
ATHENA and the Hearts and Minds Impact Tool

- **The project ATHENA**
  - part of Force Protection project managed by EDA
  - funded by 20 EU member states
  - Consortium: TNO (NL) and gathers FFI (NO), WAT (PL), iTTi (PL), VTT (FI), Airbus Defence and Space (FR) and TUT (EE) as Tier 1 partners

- **Hearts and Minds Impact Tools**
  - stand-alone training system
  - proof of concept demonstrator
  - Developed by: Airbus D&S (FR), Scensei (US), Securymind (FR) and iTTi
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Overall Architecture of the Demonstrator

- CGF Simulation Server
- DEB Server
- Computer Generated Force
- Data Exchange Bus
- Collateral Damage Generator
- "Hearts & Minds" Impact Tool
- Population data repository
- Social Network Viewer

BLUFOR G5 / G35
BLUFOR LoCon
Ex.Director & Ex.Analyst
OPFOR Operator
BLUFOR CIMIC Planner
BLUFOR MISO Planner & Analyst
Achievements and lacks of H&M Impact Tools

Achievements

• Simulates both kinetic and non-kinetic actions’ impacts on populations attitudes
• Communication between individuals of the population
• Model of ethnic conflicts
• Advanced model of broadcasted messages embodying a semantic: contextual messages and actions e.g. Health (“Distribution of medical supplies”), Security (patrol in an area),

Lacks

• Not implemented on a multi agent platform
• No scientific foundation of the model
• Do not encompass population’s affective response
• Not calibrated, not rigorously validated
Objectives of Polias

Enhanced model of attitude dynamics based on
• Psychological theories
• Representation of beliefs toward Forces

Enhanced model of communication
• Belief exchange based on cognitive science
• Among a social network

Inter-ethnic conflicts
• Model social groups and tensions

Validation
• Collect field data (opinion polls, sequence of actions)
• Calibrate the model
Classical Attitude Models in Social Simulation

Attitude dynamics first depends on its representation model

Simple models
- e.g. binary, discrete or real values [Nowak et al., 1990]
- Do not consider the construction mechanism of the attitude

[Urbig and Malitz, 2007]
- Sum of the evaluations of the object’s features
- Exchange of attitudinal information
  → attitude-beliefs connections are lost
- Agents shouldn’t have unlimited memory
An Attitude Models in Psychology

Attitude as object-evaluation associations [Fazio, 2007]

- Links between attitude and beliefs
- Limited memory and varying accessibilities
Communication

What to communicate?

• Attitude itself [Xia et al., 2010, Castellano et al., 2009]
• Or part of [Urbig and Malitz, 2007, Thiriot and Kant, 2007]
• However:
  – no psychological theory describes the impact of attitude exchange
  – conversational narratives represents up to 40% of daily communication [Eggins and Slade, 1997]

Belief exchange

To whom?

• Synthetic population
  – Small-world [Milgram, 1967]
  – GENstar Project
• Individuals - Social groups
Model: General Principle

Local Population

Social Groups

Blah

Blah

Blah

Blah

Blah

Force & Com.

Actions


Modelling the impact of beliefs and communication on attitude dynamics
Model: Agent Cognition

Beliefs = \{\text{actions}\}
\text{action} = \langle \text{force, date, payoff, beneficiary, credibility} \rangle
\text{Contacts} = \{\text{individuals}\}

\{ \heartsuit \in [-1; 1] \}
Cognitive Mechanisms

Modelling the impact of beliefs and communication on attitude dynamics

Action → Belief Revision → Attitude Revision

Force
- Strong
- Weak
- Civilian Casualty
  - Unforgivable
- Toys Distribution
  - Pleasing
Belief Revision

- **Credibility**: direct > population > Force

- **Belief revision** when individual i receives a(sender)
  - action unknown, accept a(sender)
  - know compatible, reinforce a(i)
  - know incompatible, probability to accept a(sender)

[Thirot and Kant, 2008]
Modelling the impact of beliefs and communication on attitude dynamics

Action Evaluation

Agents evaluate actions based on its payoff and their attitudes toward the beneficiaries.

\[ \text{evaluation}(a,i) = \text{payoff}(a) \times \text{att}(i, \text{beneficiary}(a)) \]

[Ajzen and Fishbein, 2005]
Accessibility of a Belief
Simplicity Theory part 1/2

Interest of an information: \( \text{INT}(a) = 2^{E(a) + S(a)} \)

- **Emotional response** \( E(a) \)
  - Weber-Fechner’s law of the stimulus: \( E(a) = \log \left( 1 + \frac{|\text{stimulus}|}{\xi} \right) \)
  - stimulus = payoff of the action’s impact
  - \( \xi \) sensibility parameter
Modelling the impact of beliefs and communication on attitude dynamics

Accessibility of a Belief
Simplicity Theory part 2/2

Interest of an information: $INT(a) = 2^{E(a)} + S(a)$

- Generated surprise
  - $S = U_{raw} - U_{perso}$
    - $U_{raw}$ raw unexpectedness
    - $U_{perso}$ personal unexpectedness
  - On multiple dimensions: $U_{time}, U_{social}$

- $U^X = C^X_w - C^X_d$
  - $X$ the dimension
  - $C^X_w$ complexity of generation
  - $C^X_d$ complexity of description
Modelling the impact of beliefs and communication on attitude dynamics

Attitude computation

\[ \text{att}(i, \text{actor}) = \sum_{ga(i) \in \text{gaList}(i, \text{actor})} \left( \sum_{a(i) \in \text{ga}(i, a)} \left( \frac{\text{evaluation}(a) \times \text{interest}(a, i))}{|\text{ga}(i, a)|} \right) \right) \]
Some Experimental Results

Modelling the impact of beliefs and communication on attitude dynamics

- Actions on A
- on B
- on C

![Graph showing attitude dynamics over time with different values of $\alpha$.]
Validation

Step 1: Gathering field data

Study case: Kapisa - Surobi in Afghanistan

• Opinion polls
  – Contracted by MinDef
  – From February 2011 to February 2013, frequency of 6 months
  – Various topics including the opinion towards Blue and Red Forces

• Action sequence
  – 6 interviews with members of CIAE
  – Open source official information on action log
  – Reconstruction of a scenario covering 4 tenures
Validation

Step 2: Calibration (work in progress)

- Scenario based on previously gathered data
- Calibration of only two model parameters for 4 points of opinion polls (early result)
Conclusion & Perspectives

We proposed an attitude dynamics model
• Based on beliefs
• With an associated interest value
• Accordingly to psycho-social and cognitive theories

Perspectives
• Real case study
• Calibration