



Simulation Team

Advanced Models for Simulation of CIMIC Operations: Opportunities & Critical Issues provided by Intelligent Agents

Modelli Avanzati di Simulazione di Operazioni CIMIC: Criticità e Opportunità Offerte dagli Agenti Intelligenti

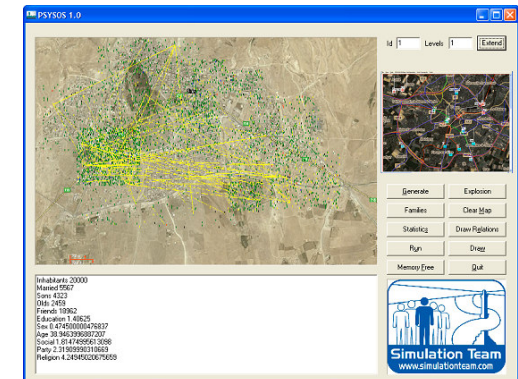


Agostino G. Bruzzone, Marina Massei
MISS DIPTM University of Genoa
 {agostino,massei}@itim.unige.it - www.itim.unige.it

Alberto Tremori, Enrico Bocca
MAST
 {alberto.tremori, enrico.bocca}@simulationteam.com



Francesca Madeo
Simulation Team
 francesca.madeo@simulationteam.com





Who We Are?

Universities, Research Centers and Companies operating worldwide in synergy for developing Innovative Solutions with a particular focus in Modelling and Simulation



DIPTM
Università
di Genova



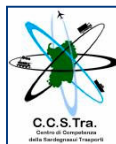
MAST



McLeod Institute of
Simulation Science
Genoa



CIREM
Università di Cagliari



CCSTra
Cagliari



M&S Network
MS-LES



Euridice



Australia

Log.In.Form.

Logistica
Informazione
Formazione



Blizzard srl



AntOptima



TURiga



DIPMEC
Unical



Universitat Autònoma
de Barcelona



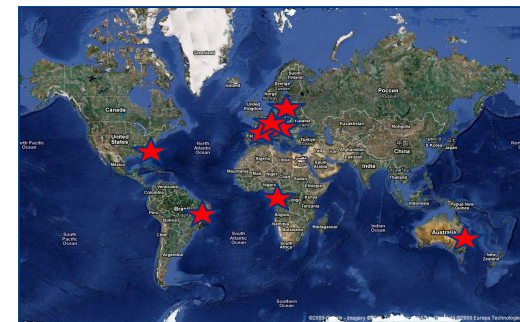
MISS
Università di Perugia



LISIS
Marseille



MISS Brazil
LAMCE RIO



DIPTM
Università di Genova



Windhoek
Namibia



LISIS
Marseille



Simulation Team



McLeod Institute Simulation Science M&S Net Genoa Center

Email: agostino@itim.unige.it

URL: www.itim.unige.it/mcleod
www.simulationscience.org

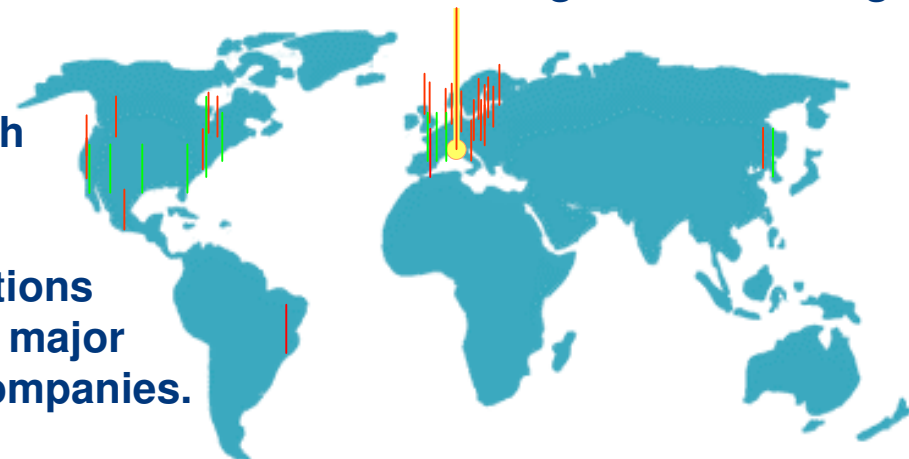


The research group of DIPTM of *Genoa University* is active from '60 in Simulation applied to Industrial Engineering and is part of MISS and M&S Net. The activities involve modeling, simulation, VV&A and analysis of Industrial Applications and Services (design, re-engineering, management, training etc.)

as:

Chemical Facilities	Power Plants	PM
Harbor Terminals	Public Services Environment	
Manufacturing	Assembling	Logistics
Public Transportation		

The Department staff is in touch world-wide with the simulation community and is present actively to conferences, exhibitions and working meetings with the major Associations, Agencies and Companies.

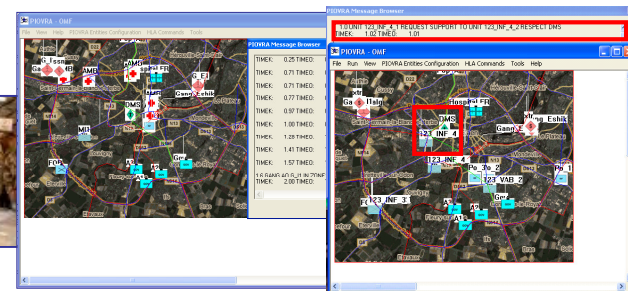


28 MISS Centers, 34 M&S Net Centers World-Wide



Objectives

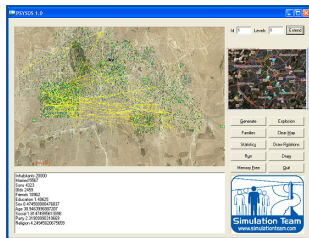
- To identify the opportunities in simulating CIMIC by using new generation Computer Generated Forces (CGF) based on Intelligent Agents (IA)
- To present the critical issues and potential of Intelligent Agents devoted to direct new CGF
- To present the importance of Psychological & Social Human Behavior Modifiers (HBM) in the S&R Operations
- To define a testing scenario for VV&A of this approach
- To develop Models representing the strategic issues in this framework.





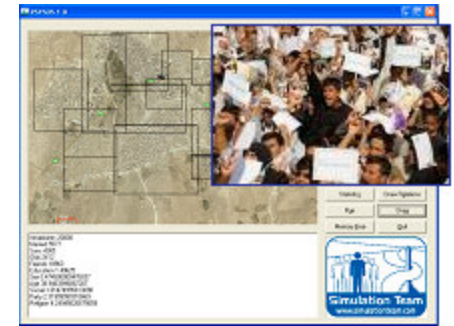
Using IA, CGF and HBM in Military Simulation

- New Technologies and Models involving IA, CGF & HBM are a strategic in different application areas such as:
 - **Training and Exercise**
 - Reduction of human personnel operating directly the simulation system during CAX
 - New Scenarios involving dynamic simulated White Cells and Complex System (i.e. population) vs. the old pre-defined scripts
 - **Operational Planning**
 - Reducing Time for Planning Development due to the reduction of human experts employed in the different roles
 - Possibility to Experiments different Alternatives by replicated runs carried out in Automatic way.
 - **Mission rehearsal and conduct operations**
 - Capability to keep the simulation on-line and to conduct statistical experimental analysis.





Model Elements for S&R



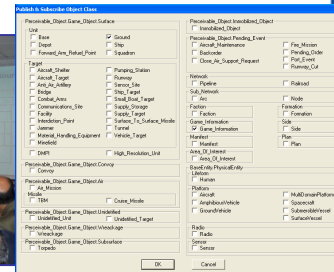
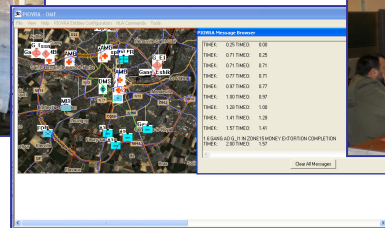
- Obviously in order to be successful in representing S&R (Stabilization and Reconstruction) operations from user point of view by modeling Urban Socio-Culture-Economy Geography it is critical to properly define the components and elements of the simulation model to be used. In this case the model proposed herein requires an initial functionality to include:
 - **Civilian population entities**
 - **Select beliefs and positions held by those entities**
 - **Social network connecting the population entities**
 - **Set of actions that can influence the population entities**



CAPRICORN Project

Civil Military Co-operation And Planning Research in Complex Operational Realistic Network

- CAPRICORN is an active EDA R&D Project devoted to develop capabilities in the complex and critical sector of Military Operation Planning, specifically for asymmetric warfare scenarios involving CIMIC and PSYOPS, by using CGF (Computer Generated Forces) based on Intelligent Agents (IAs)





PIOVRA Background for CAPRICORN

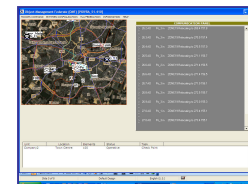


CAPRICORN benefits from the results in development of Intelligent CGF of PIOVRA (Polyfunctional Intelligent Operational Virtual Reality Agents) Project where the following Object was created:

Comportment Objects are dedicated to the simulation of actors that represents behaviors of populations, movements or analog entities to where units on the field belongs.

Action Objects units with the task of simulating elements acting the scenario (i.e.military unit, terrorist, leader) or events (i.e.riots, demonstrations) Action Objects are referencing corresponding Comportment Object with mutual and are characterized by mutual influence

Support Objects include objects representing influent phenomena corresponding to boundary conditions such as Environment Data Representation including Zone, Layer and Weather Objects.

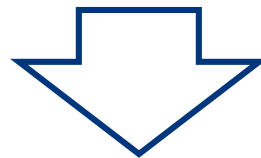




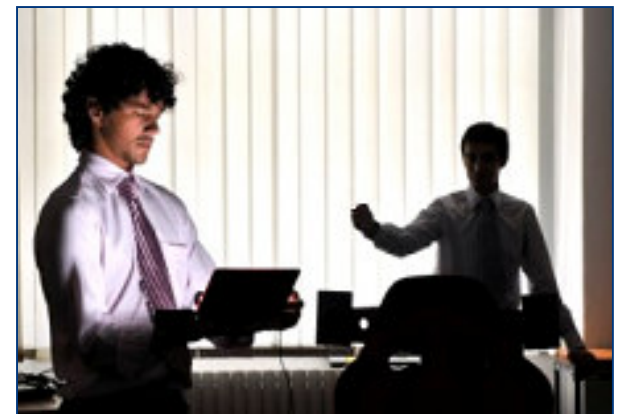
PIOVRA Results

Which are the results of PIOVRA projects to be integrated with constructive simulation?

- A Generation of new “Intelligent” CGFs able to simulate autonomously human behavior
- Modelling of complex human behavior taking into account psychological and sociological parameters.



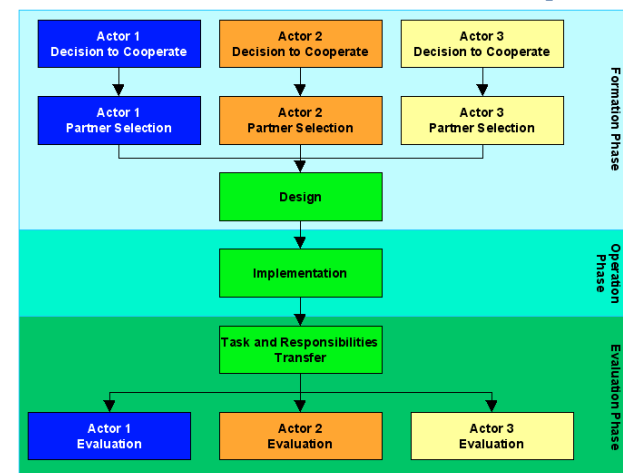
- Opportunity to model Complex Problems such as: CIMIC and Country Reconstruction





CIMIC Military Relevance & CAPRICORN Project

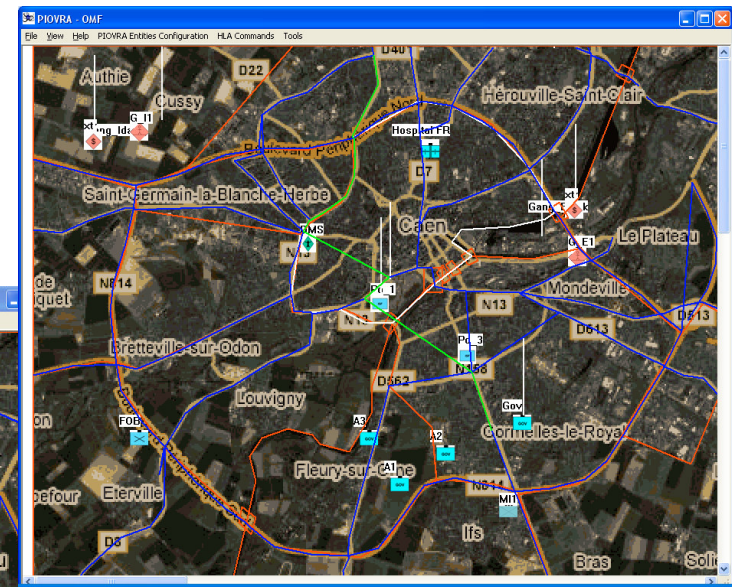
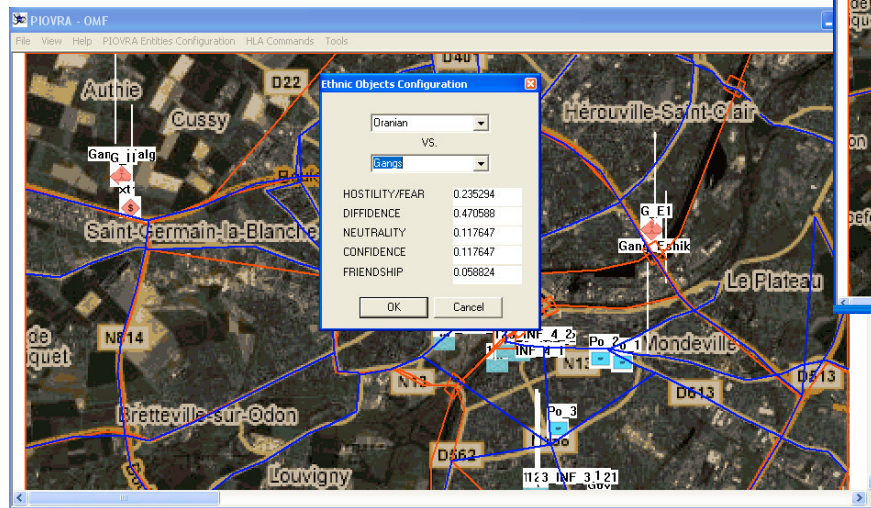
- *The CIMIC type activities now days constitute a significant portion of the total military effort. The forces engaged in operations not Art. 5/St.Petersburg, both for their value in the territory that for the external visibility of the operations themselves, are under the world opinion evaluation.*
- *CIMIC are critical issues in S&R (Stabilization and Normalization) operations as well as during Stabilization and Normalization phases of most of current scenarios.*
- *CAPRICORN Project is focused on creating new CGF for simulation of CIMIC able to consider key operational and territorial factors also in the planning and exercises stages.*





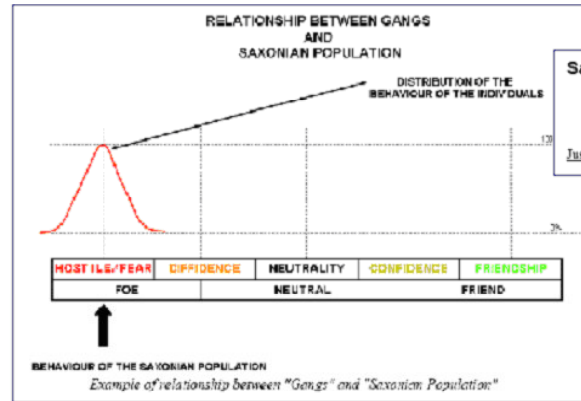
Action & Comportment Objects

- The different Units are driven by the Agents and apply different procedures and ROE based on:
 - Their configuration and Nature
 - The Perception of the Scenario
 - The Order Received
 - The Previous Experiences





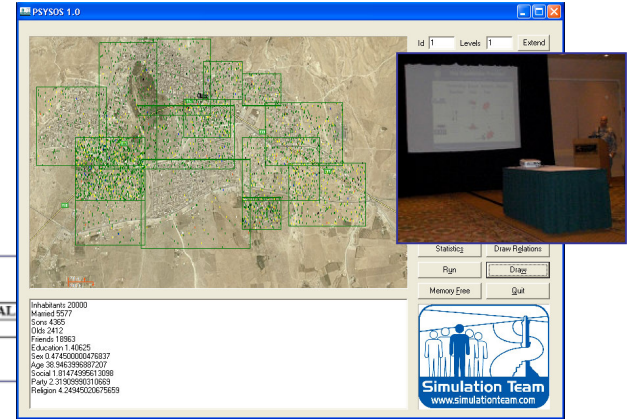
Example of Mutual Influence among Ethnics



Saxonian Population vs Gangs

HOSTILE/FEAR	DIFFIDENCE	NEUTRAL
100%	0%	0%

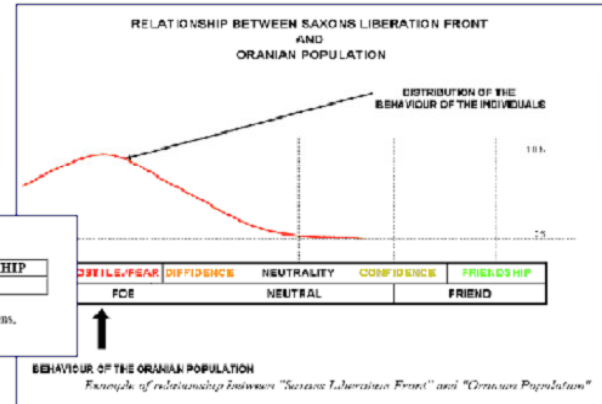
Justification: Saxonian Population fears Gangs.



Saxons Liberation Front vs Oranian Population

HOSTILE/FEAR	DIFFIDENCE	NEUTRALITY	CONFIDENCE	FRIENDSHIP
40%	30%	20%	10%	0%

Justification: although most of the Oranian Population fears the Saxons Liberation Front terrorist actions, the SLF is also considered as an help to destroy the "status quo" imposed by the Montreux Federation.



The Attitudes among the IA are based on Fuzzy Representation and their interaction are regulated y Artificial Intelligence techniques



***IA-CGF* MODULES**

The new *IA-CGF* Modules devoted to create the CIMIC simulation include:

- *IA-CGF Units*
- *IA-CGF Human Behaviors*
- *IA-CGF Non-Conventional Frameworks*





IA-CGF Units

IA-CGF Units are a set of interoperable units with capability to be integrated in constructive simulation

- Police
- Gangs
- Local Population
- Rioters
- Insurgents
- Terrorist
- Local Authorities
- Warlord
- Criminal Organizations
- NGOs (CIMIC ops.)
- Civil Personnel (CIMIC ops.)
- Domestic/National Situation (for instance for troops morale)
 - Population
 - Media
 - Lobbies
- International Public Opinion
- International Diplomacy
- New Threats (i.e. 2nd Generation Terrorists)



These are examples of non-conventional units controlled by IA-CGF

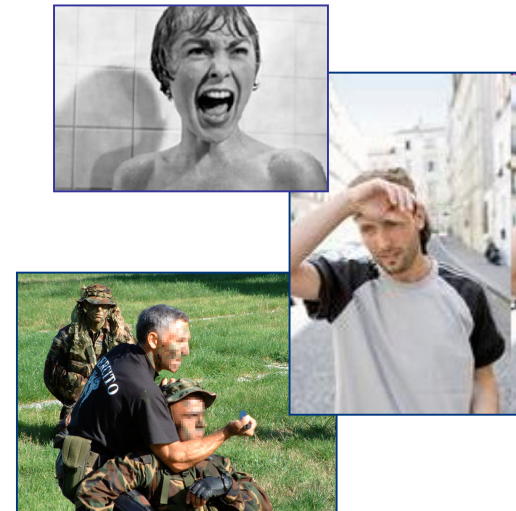




IA-CGF Human Behaviors

Specific modules with *IA-CGF Human Behaviors*:

- Fear
- Stress
- Fatigue
- Training Level
- Aggressiveness
- Ethnic Factors
- Religious Factors
- Combat Skills/Experience



IA-CGF Human Behaviors operate as a set of further characteristics to be added to each unit in constructive simulation.

i.e. now in constructive simulation every unit in the scenario have infos about status and type of ammo, by *IA-CGF* it will be added dynamic information about level of fear and stress and the Units performing according to it



IA-CGF Non-Conventional Frameworks

It is important to consider the integration in a scenario of the *IA-CGF-Non-Conventional Frameworks (IA-CGF-NCF)*, each simulating specific events:

- *IA-CGF CIMIC/HUMANITARIAN FRAMEWORKS*

- Food Distribution
- Reconstruction



- *IA-CGF Homeland Security and Civil Protection FRAMEWORKS*

- Natural Disaster
- Evacuation



- *IA-CGF PSYOPS and INTELLIGENCE FRAMEWORKS*

- Possible integration with *Sibilla*® Serious Game for Intelligence Officers training

In non conventional scenarios for particular training purposes.

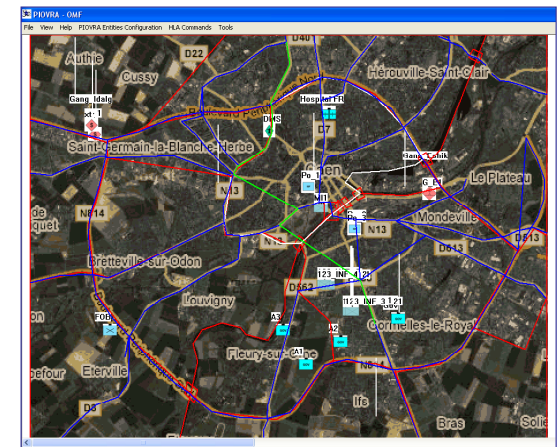
We can imagine to have active different non conventional Frameworks, in different locations, with different level of detail inside the simulated theater.





CIMIC Comportment Objects

- In the **CIMIC** scenario **Comportment Objects** will reproduce:
 - Population
 - Ethnic Groups
 - Cultural Layers
 - Social Layers
 - Local Communities
 - Public Institutions
 - Governmental Entities
 - Local Administrations
 - Schools
 - Health Care Systems
 - Political Parties
 - Military Organizations
 - Local Army
 - Allied Forces
 - Opposite Forces
 - Neutral Forces
 - Paramilitary Organizations
 - Police Forces
 - Warlords
 - Insurgents
 - Terrorists



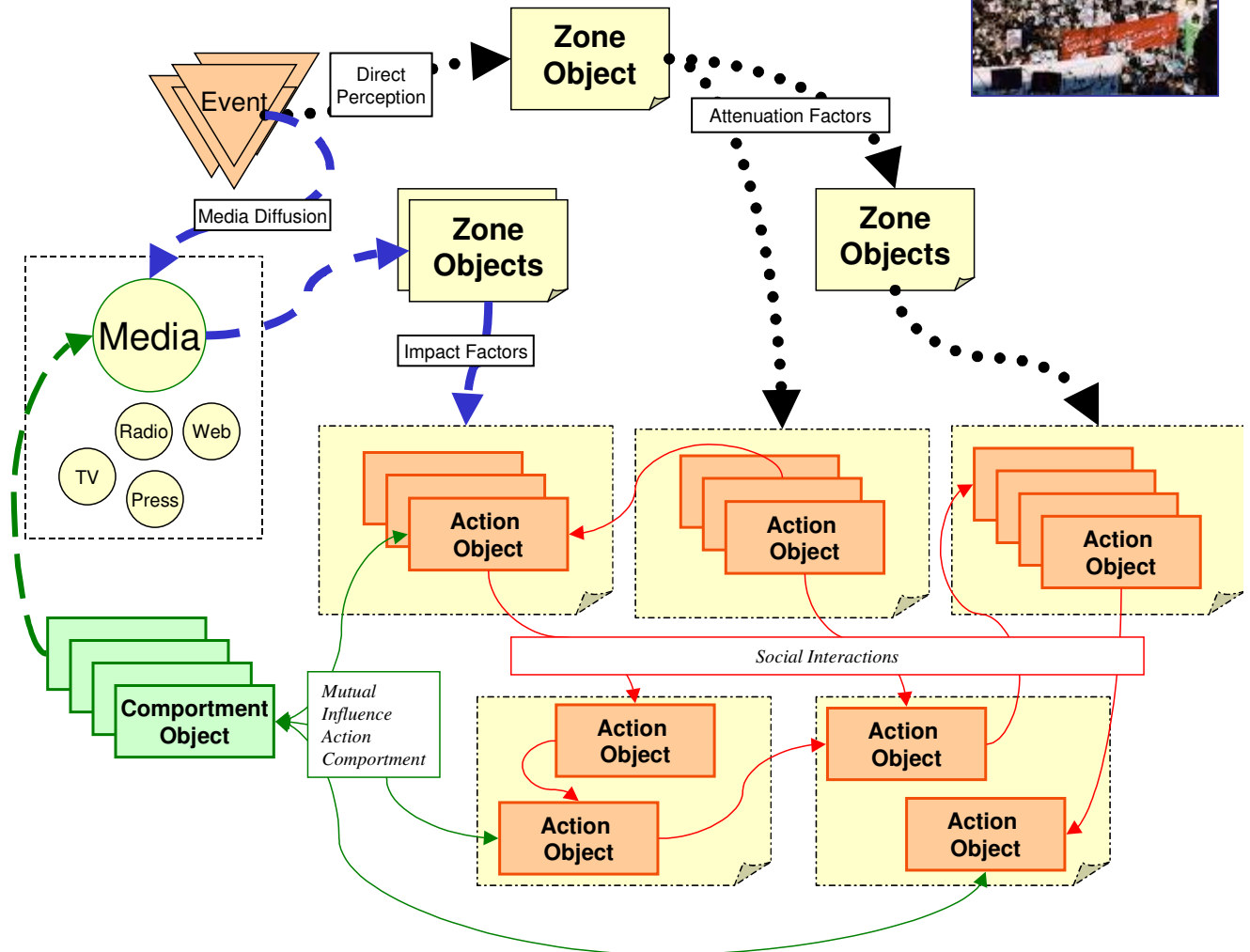


Interoperable Models



The evolution of the situation requires models such as:

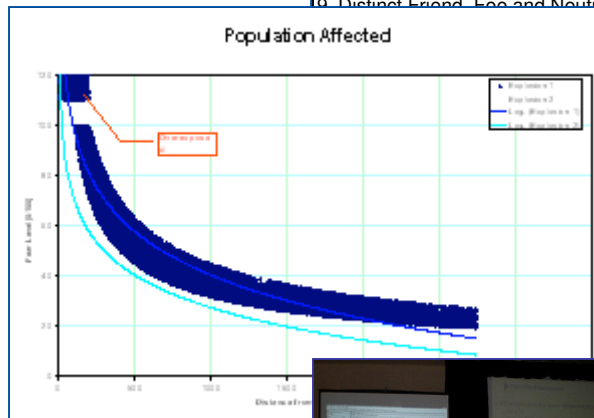
- Civilian Attitude Model: describes changes in population attitude as a result of Host Nation actions and insurgency activities, and perceived good/bad actions.
- Social Network Model: helps to describe civilian response to new factors that interact with civilian behaviors, social structures and specific communication parameters as hierarchy and message contents.
- Economic Model: describes how the economic decision of a Host Nation can affect and impact the attitude and activities of entities.





VV&A Features

Feature/Objective	Present	Example and Note
1. User-Defined Initializing Parameters	YES	The user defined the profile of the Gang as well as the ROE to be used by Blue Units
2. Analyze Surrounding Environment and React Respectively Capability	YES	The Blue Units encountering the Riot and the Gang takes actions to stop the looting
3. Cooperation Capacity	YES	Some Blue unit are providing support on others reaching the demonstration/riot
4. Force Aggregating/Disaggregating Capability and relevant military hierarchy	YES	Disaggregation of Blue unit in two Squads after dissolution of the Riot
5. Resultant Aggregation Levels different from aggregating/disaggregating elements sum/subtraction	YES	The combination of Demonstration and Gang looting create impact on the area different from the sum of the single entities and introduces the generation of a riot
6. Limit Proper Autonomy to Achieve Common Objective Capability	YES	It is possible to enable/disable the possibility for the Blue Unit to request direct support to the other ones and to let the scenario evolve with this other condition
7. Stress Level Indicator applicable for the entities behavior definition	YES	These aspects affect both Population and Military Units all along the simulation
8. Implementation of Typical Human Behavior (survival instinct and moral/ethical motivations)	YES	It is possible to enable/disable the feature and check, versus critical riots, the different respect of ROE by Military Units
9. Distinct Friend, Foe and Neutral Units Behavior	YES	Distinction between Gang and Militia
Commanders Capability	YES	Each entity provides a Log including the conditions under what each different ROE applied
	YES	Each entity provides a Log related to the factors affecting their actions
	YES	Blue Unit moving among cells of an ethnic group affects the population evolution and the eventual creation of a Riot
	YES	A single entity is representing the agitators that change the attitude of the demonstration/riot
	YES	The militia unit is corresponding to a team
	YES	The Blue Unit in patrol corresponds to a Squad
	YES	The Blue Unit providing support corresponds to a Platoon
	YES	Reports about actions and events are distributed as interaction in the HLA Federation during Simulation Runs



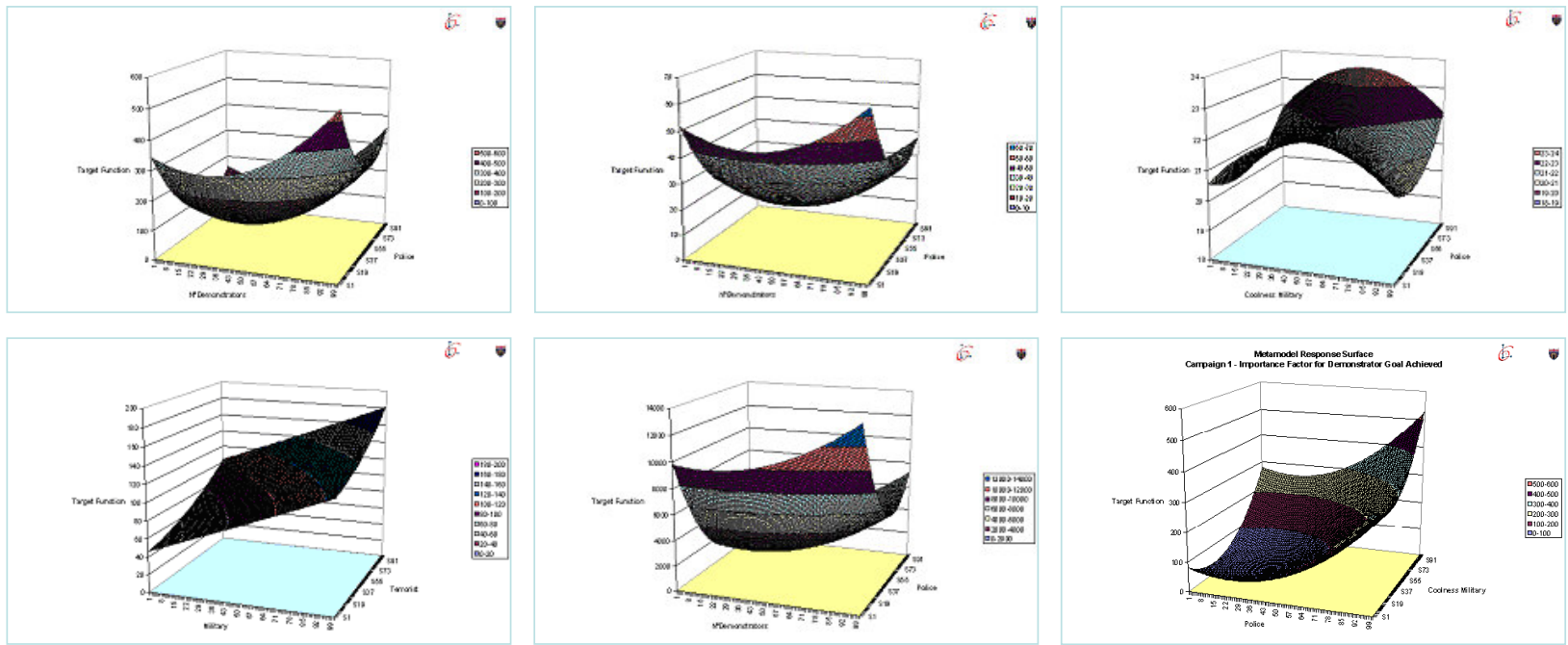
Example of Testing the Features in PIOVRA

It is critical to guarantee proper VV&A for models especially due to HBM and Interoperability Issues





Example of Scenario Experimental Analysis



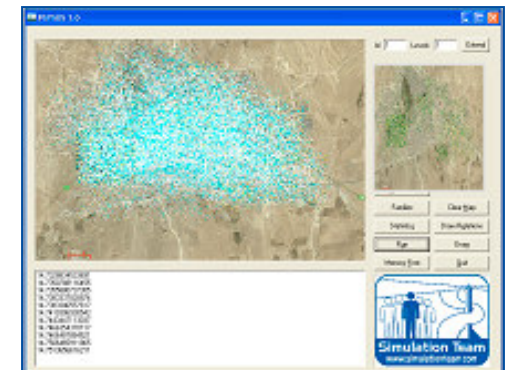
Example of Response Surface Methodology and Design of Experiments obtained by running PIOVRA scenarios and correlating urban stabilization metrics with operational planner actions





Conclusions

- Authors' aims is to develop a architectures, models and algorithms path for creating common framework for supporting S&R foundations. Main objective is to model CIMIC in SASO (Stability and Support Operations) scenarios.
- The major benefit expected by applying IA-CGF in CIMIC operations is the possibility to introduce many agents able to drive and direct actions of involved entities and organizations with strong and complex interactions; so that
- The Intelligent Agents make their decisions on scenario awareness and mutual interactions dynamically changing



References



DIPTM

DIPTM University of Genoa
 via Opera Pia 15
 16145 Genova, Italy
www.itim.unige.it
Agostino G. BRUZZONE
agostino@itim.unige.it



LSIS

LSIS
 Av Escadrille Normandie Niemen
 13397 Marseilles, France
www.lsis.org
Claudia FRYDMAN
claudia.frydman@lsis.org



MAST

MAST
 Simulation Lab, via Molinero 1
 17100 Savona, Italy
www.mastsrl.eu
Alberto TREMORI
alberto.tremori@simulationteam.com

