**Annual Report of the McLeod Institute of Technology and Interoperable Modeling & Simulation**

**Simulation Team Genoa Center, Italy**

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| **List of Research Activities & Projects**<br>**-Subject**<br>**-Type [Topic/Project]**<br>**-Description**<br>**-Year** | **Industrial Business and Defense**<br><br>**Project: T-REX (Threat network simulation for REactive eXperience)**<br>**T-Rex (Threat network simulation for REactive eXperience) is a MS2G (Modeling, interoperable Simulation & Serious Game) devoted to reproduce Hybrid Warfare and to be federated with other elements to evaluate the impact of these actions. T-REX reproduces urban, as well as extra urban contexts over multiple domains including land, air, sea, space and cyberspace. The models allows to consider media communications and possibility to use different assets and to experiment virtually the different decisions in terms of COAs (Courses of Actions)**<br>**2015-ongoing**<br><br>**Project: FASOLT (Foremost Autonomous Solutions for Operations in industriaL plant)**<br>**Simulation Team developed Innovative Solutions for Industrial Plants based on Autonomous Systems, Artificial Intelligence and Modeling & Simulation, XR (eXtended Reality). The Project addresses mainly the Safety within Industrial Plants and it generated very interesting results on several issues**<br>**2016-ongoin**<br>**Project: SO2UCI (Simulation for Off-Shore, On-Shore & Underwater Critical Infrastructure=**<br>**SO2UCI is a Simulation for Training on protecting Off-Shore and On Shore Infrastructures (e.g. oil rig, gas rig), On-Shore Critical Infrastructures (e.g. ports, power plants, refineries, desalinators) and Underwater Critical Infrastructures (e.g. cables, pipelines) from Asymmetric Threats using conventional assets and autonomous systems (e.g. RHIB, Helicopters, Sensors, UAV, USV, AUV,Gliders, etc.). The simulator is interoperable by using HLA (High Level Architecture) and support integration with real equipment as well as with other simulators and solutions as the SPIDER. SO2UCI integrates scenarios for training the use of** |

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| | **specific sensors on rotary wing UAV to discriminate suspect boats invading the perimeter of Oil Rig (e.g. face recognition, thermal camera, etc.)**<br>**2014 on-going**<br><br>**Project: DIES-IRAE (Disasters, Incidents & Emergencies Simulation & Interoperable Relief Advanced Evaluator)**<br>**DIES-IRAE uses Interoperable IA-CGF to reproduce Humanitarian and Disaster Relief Missions. Simulation Team is applying this simulator on a Scenario inspired by South Sudan Crisis and conducting experiments for quantify the Potential of this approach and to Demonstrate the effectiveness of the MS2G (Modeling, Interoperable Simulation & Serious Games) in this context DIES IRAE is a simulator addressing logistics, food distribution, health care, temporary housing, military support and administrative support**<br>**2014 on-going**<br><br>**Project: DROTHS (DROne THreat Simulator)**<br>**DROTHS is a MS2Gs (Modeling & Interoperable Simulation and Serious Game) devoted to investigate the vulnerabilities due to the use of Drones, UAV (Unmanned Aerial Vehicles), UGV (Unmanned Ground Vehicles), UUV (Unmanned Underwater Vehicle), USV (Unmanned Surface Vehicle) and other Autonomous Systems. The Scenario covers Multiple Mission Environments including the Protection of Critical Infrastructures. DROTHS simulates the interactions of Drones with other assets including traditional ones over multiple domains, including Cyber. This approach allows to simulate Hard & Soft Kill and different Doctrines & Technologies. DROTHS quantifies Risks, Vulnerability Levels, Damages, Measure of Merits.**<br>**The Simulator is able to operate Stand Alone as well as HLA Federate and it is driven by Intelligent Agents Driving Actions of Different Parties & Civilians.**<br>**2014 on-going**<br><br>**ALACRES2 (Advanced Laboratory for Crisis and Emergencies in Ports and marine domain developed by Simulation within a common collaborative Space)**<br>**The aim of the ALACRES2 Project is to to activate a Permanent Laboratory able to identify, test and validate integrated emergency management procedures in the case of accidents, crises or significant accidents occurring during the loading and unloading of goods and dangerous substances; There memorize options in order to identify unified organizational and behavioral management protocols to assist the improvement of workers' skills in the emergencies of one of the phases of greatest weakness and criticality within the logistics chain of this type of goods, determined by the physical discontinuity in the passage from the sea side to the land side (and vice versa). The ALACRES2 has the task to investigate the behavior of the various operational figures called to the management of emergencies in the event of an accident during the boarding and disembarking procedures, testing new behavioral protocols, new operating** |

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| | **standards, new procedures for monitoring and control of the emergency, new support technologies for infrastructure and on-board systems.**<br>**2018 on-going**<br><br>**PONTUS (POpulation behavior, social Networks, Transportation, infrastructures and industrial Urban Simulation)**<br>**PONTUS supports decision makers in the management of critical events such through simulation and different models addressing Population behavior, social networks, transport and urban simulation PONTUS operates based on concept MSaaS (Modeling & Simulation as a Service) and it adopts the MS2G Paradigm (Modeling, interoperable Simulation and Serious Games) by using Intelligent Agents to reproduce behavior of individuals as well as social networks. PONTUS supports Strategic Planning, Operational Planning and Simulation of Operational Activities, emergencies and containment measures, crisis management, development of decision support systems. It has been applied to cases dealing with Urban Strategic Planning, Crisis Management due to Floods as well as CBRN Threats and Hazardous Material Spills in Air and Rivers.**<br>**2015 on-going**<br><br>**TOPRO (Town Protection during pandemics and CBRN crisis by SIM4Future, Simulation Team)**<br>**TOPRO is devoted to support the operations related to protecting a Town or a Region during a epidemics and contamination crisis. The System reproduce People Behaviors, Units and Entities as well as activities related to Protection, Cordoning of Areas and Cities to protect them from Contaminations and Epidemics as well as planning of decontaminations and treatments and resource allocation. Entities include law enforcements, military units, health care resources, sensor networks, social media info. TOPRO allows to Identify the Critical Areas and Part of a Town at Risk, as well key points and sectors to control in case of detection of infected people and it provides support for tracking them. TOPRO is a Decision Support System able to be used for training, education as well as operational planning and operation support, Check Points Organizer and Management Tool during Pandemics and CBRN crises. TOPRO aims to support also training and operational planning for isolation and containment of epidemics**<br>**2020 on-going**<br><br>**VESTIGE (Virus Epidemics Simulation in Towns & Regions for Infection Governance during Emergencies)**<br>**The proposed Technological Solution is applied to Pandemics and it based on the innovative Strategic Engineering to address pandemics, the proposed approach integrates Simulation, Artificial Intelligence and Data Analytics in closed loop to support decisions based on scenario evolution and human behavior and population modeling. The current approach has been already demonstrated in relevance to Smart Government and several applications, including PONTUS & Decision Theatre, have been already employed in Operations and Strategic Planning as part of** |

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| | **Smart City Project. Therefore, the conceptual models and simulation experimentations on pandemics have been carried out by Scientists of Genoa University and Senior Partners of SIM4Future since over 10 years with specific attention to Pandemics, Epidemics and CBRN (Chemical, Biological, Radiological and Nuclear). The very innovative aspect of this solution relies on its capability to reproduce human behavior of population and interest groups, coupled by Intelligent Agents and reproducing individuals & social networks considering Age, Gender, Health Status, Social level, Education, Ethnics, Religion, Political Preferences and other attributes, including psychological modifiers (e.g. fear, stress, fatigue, aggressiveness). By this approach it turns possible to evaluate different courses of Actions and to keep forecasts about effectiveness of applied measures aligned with data collected on field and media.**<br>**2020 on-going**<br><br>**COYOTE (Container terminal Operations and Yard Operator Training and Education by extended Reality)**<br>**COYOTE is focused on developing intuitive solutions to experience within a digital twin a challenging environment respect Efficiency, Effectiveness, Productivity and Safety. The goal is to be able to Experiment Virtually new solutions as well as new procedures to increase productivity and reduce Risks. Extended Reality within the MS2G Paradigm (Modeling, interoperable Simulation and Serious Games) allows to combine the benefits of Serious Games in terms of Engagement and Usability with the Fidelity of Simulation. The use of such innovative Solutions could support both Experimentation, New Procedure Design as well as Training**<br>**2019 on-going**<br><br>**RECASD (Retail Competition enhancement by Artificial intelligence, Simulation and Data Analytics)**<br>**RECASD is an Innovative Strategic Engineering approach devoted to promote marketing campaigns based on Data Analytics on Big Data, Machine Learning using Artificial Neural Neworks, Genetic Algorithms and Simulation to optimize the Retail Business); the project is developed in joint connection with Simulation Team, SIM4Future**<br>**2019 on-going**<br><br>**IT WETS (Innovative Technologies for Water Education & Training Solutions)**<br>**MS2G Solution (Modeling, interoperable Simulation & Serious Game) devoted to improve the Strategic Water Management by creating a realistic scenario to experience virtually including engineering, economics, geo political, diplomatic, homeland security and defense issues.**<br>**2010 on-going**<br><br>**Green Steel STRATENG (Strategic Engineering)** |

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| | **New Industrial plant projects devoted to investigate by Strategic Engineering, the most promising opportunities to produce Steel using Hydrogen**<br>**2020 on-going**<br><br>**New Clear STRATENG (Strategic Engineering)**<br>**Use of Strategic Engineering architectures for studying new energy projects devoted to investigate the potential of new nuclear plant solutions and their engineering, economic, environmental and social impact with special attention to Molten Salt Reactors in power production and marine solutions**<br>**2020 on-going**<br><br>**StratProm (Strategic engineering and Project Management)**<br>**Use of Strategic Engineering architectures for large projects, including EPCC (engineering, procurement, construction, commissioning) of in large offshore Platforms and FPSO (Floating Production Storage and Offloading Unit)**<br>**2018 on-going** |
| **List of Educational**<br>**-Title**<br>**-Type [University Course/Professional Course]**<br>**-Year** | **Genoa University:**<br>**MSc in Strategic Engineering since 2019**<br>**Post Graduate Course: MIPET, Industrial Plant Engineering : University of Genoa 13 Editions since 2010**<br>**PhD Courses, University of Genoa, Italy, 2012-2013 "Modeling & Simulation", "Project Management & Concurrent Engineering in R&D Projects", "VV&A"**<br><br>**New PhD Program in Strategic Engineering since 2021**<br>**PhD Program In Mathematical Modeling and Simulation (DIMS) since first decade of this Millennium**<br><br>**Professional Courses in Italy 2000-2022**<br>**Simulation Team and M&S Net Modules on M&S, VV&A, Interoperability, PM in M&S**<br>**SIBILLA Educational Modules for Italian MoD on M&S** |
| **Scientific Publications** | • **Bruzzone, A. G., Massei, M., & Frosolini, M. (2022). Redesign of Supply Chain in Fashion Industry based on Strategic Engineering. Procedia Computer Science, 200, 1913-1918.,,**<br>• **Redesign of Supply Chain in Fashion Industry based on Strategic Engineering,AG Bruzzone, M Massei, M Frosolini - Procedia Computer Science, 2022 - Elsevier,**<br>• **A Critical Analysis on Green and Low-Temperature Methods for the Production of Carbon Nanoparticles, AP Reverberi, M Vocciante, AG Bruzzone… - Chemical Engineering …, 2021 - cetjournal.it**<br>• **Strategic Engineering Applied to Complex Systems within Marine Environment,AG Bruzzone, M Massei… - 2021 Annual …, 2021 - ieeexplore.ieee.org**<br>• **Strategic Engineering to Develop Strategies during a Crucial Period, AG Bruzzone, M Massei - Digital Transformation in a Post-COVID …, 2021 - taylorfrancis.com,** |

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| | • Enabling strategic decisions for the industry of tomorrow, A Bruzzone, M Massei, K Sinelshnkov - Procedia Manufacturing, 2020 - Elsevier,<br>• Modelling of the microrelief impact to the cross country movement J Mazal, M Rybanský, AG Bruzzone… - Proceedings of the …, 2020 ,<br>• Town Protection Simulation, AG Bruzzone, K Sinelshchikov, M Massei… - Proceedings of …, 2020 - scholar.archive.org,<br>• Word of Mouth, Viral Marketing and Open Data: A Large-Scale Simulation for Predicting Opinion Diffusion on Ethical Food Consumption, AG Bruzzone, M Agresta, JH Hsu - International Journal of Food …, 2020 - degruyter.com,<br>• A digital twin approach to develop a new autonomous system able to operate in high temperature environments within industrial plants, AG Bruzzone, R Cianci, A Sciomachen… - … of Summer Simulation …, 2019 - 123dok.org,<br>• Application of blockchain in interoperable simulation for strategic decision making, AG Bruzzone, M Massei, K Sinelshchikov - Proceedings of the 2019 …, 2019 - dl.acm.org,<br>• Improving data consistency in Industry 4.0: an application of digital lean to the maintenance record process, F Longo, L Nicoletti, A Padovano, AG Bruzzone… - European Modeling & …, 2019 - cal-tek.eu<br>• Libra ad bellum novum: a political and military escalation in the near east as scenario for support advanced strategic decision making, AG Bruzzone, M Massei, G Fabbrini, M Gotelli… - Proceedings of the …, 2019 - dl.acm.org,<br>• Mixed reality for industrial applications: interactions in human-machine system and modelling in immersive virtual environment AG Bruzzone, G Fancello, M Daga… - … of Simulation and …, 2019 - inderscienceonline.com<br>• NATO needs of Future Strategic Engineers, J Mazal, AG Bruzzone - Workshop on Applied Modelling & Simulation, 2019 - liophant.org,<br>• NATO use of modelling and simulation to evolve autonomous systems, J Mazal, A Bruzzone, M Turi, M Biagini… - … Challenges in Cyber …, 2019 - books.google.com<br>• Introducing intelligence and autonomy into industrial robots to address operations into dangerous area AG Bruzzone, M Massei, R Di Matteo… - … Conference on Modelling …, 2018 - Springer<br>• LAWs: Latent Demand for Simulation of Lethal Autonomous Weapon Systems, AG Bruzzone, G Franzinetti, M Massei… - … on Modelling and …, 2018 - Springer<br>• Learning decision making processes at strategic level based on VR & augmented reality, A Bruzzone, M Massei, F Longo, R Di Matteo… - Workshop on Applied …, 2018 - liophant.org, |

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| | • **Modeling and simulation as support for development of human health space exploration projects, AG Bruzzone, M Massei, G Mùrino, R Di Matteo… - Proceedings of The 9th …, 2018 - ep.liu.se**<br>• **Modeling, interoperable Simulation and Serious Games (MS2G) for healthcare and first responders in disasters within industrial plants, AG Bruzzone, M Massei, R Di Matteo - Proceedings of the 50th …, 2018 - dl.acm.org**<br>• **Modelling and optimization of the air operational manoeuvre, AG Bruzzone, J Procházka, L Kutěj… - … on Modelling and …, 2018 - Springer,**<br>• **An underwater buoyancy-driven glider simulator with Modelling & Simulation as a Service architecture, M Oddone, A Bruzzone, E Coelho… - … of Defense and …, 2017 - sce.carleton.ca**<br>• **Modeling within a synthetic environment the complex reality of mass migration, AG Bruzzone, M Massei, PD Bella, M Giorgi… - Proceedings of the …, 2017 - scs.org**<br>• **Simulation-based military training AG Bruzzone, M Massei - Guide to Simulation-Based Disciplines, 2017 - Springer**<br>• **Strategic Engineering & Innovative Modeling Paradigms, AG Bruzzone, R Di Matteo… - Workshop on Applied …, 2017 - liophant.org,**<br>• **A model to describe hybrid conflict environments. E Cayirci, A Bruzzone, F Longo… - … Modeling & Simulation …, 2016 - diva-portal.org,**<br>• **Autonomous systems for operations in critical environments, AG Bruzzone, F Longo, M Agresta, R Di Matteo… - Proceedings of the …, 2016 - dl.acm.org**<br>• **Disasters and emergency management in chemical and industrial plants: drones simulation for education and training, A Bruzzone, F Longo, M Massei, L Nicoletti… - … Workshop on Modelling …, 2016 - Springer ,**<br>• **Infrastructures protection based on heterogeneous networks.,AG Bruzzone, M Massei, S Poggi - Int. J. Simul. Process. Model., 2016 - scholar.archive.org,**<br>• **Simulation Based Design of Innovative Quick Response Processes in Cloud Supply Chain Management for "Slow Food" Distribution,AG Bruzzone, M Massei, F Longo, D Scalzo… - … Methodology, Tools and …, 2016 - Springer,**<br>• **Simulation of manned & autonomous systems for critical infrastructure protection,AG Bruzzone, M Massei, GL Maglione… - Proceedings of I3 M …, 2016 - msc-les.org,**<br>• **Virtual and augmented reality as enablers for improving the service on distributed assets,AG Bruzzone, M Massei, GL Maglione… - Proc. of I3M, Larnaca …, 2016 - liophant.org,**<br>• **Human behavior simulation for smart decision making in emergency prevention and mitigation within urban and industrial environments,AG Bruzzone, M Massei, M Agresta… - Proc. 27th EMSS Eur …, 2015 - researchgate.net,**<br>• **Intelligent agents & interoperable simulation for strategic decision making on multicoalition joint operations,AG** |

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| | Bruzzone, M Massei, F Longo, L Nicoletti… - Proc. of DHSS2015 …, 2015 - msc-les.org,<br>• Multi-disciplinary approach to disasters management in industrial plants,B Agostino, C Laura, L Francesco… - Proceedings of the …, 2015 - dl.acm.org,<br>• New enabling technologies and solutions for car terminals procedures enhancement and operators training,A Bruzzone, F Longo, M Massei… - … Journal of Supply …, 2015 - researchgate.net,<br>• Addressing strategic challenges on mega cities through MS2G,AG Bruzzone, M Massei, M Agresta, S Poggi… - Proceedings of MAS …, 2014 - msc-les.org,<br>• An application methodology for logistics and transportation scenarios analysis and comparison within the retail supply chain A Bruzzone, F Longo - European Journal of Industrial …, 2014 - inderscienceonline.com,<br>• Disaster and emergency management simulation in industrial plants AG Bruzzone, M Frascio, F Longo… - Proc. 26th Eur. Model …, 2014 - researchgate.net,<br>• Human modeling for multi coalition joint operations,AG Bruzzone, F Longo, M Massei… - Proceedings of the 2014 …, 2014 - dl.acm.org,<br>• Learning impact evaluation of the serious game "Cultural Awareness–Afghanistan Pre-deployment",A Barbieri, A Tesei, A Bruzzone… - Int. J. Serious …, 2014 - pdfs.semanticscholar.org,<br>• Safety and security in fresh good supply chain,AG Bruzzone, F Longo, M Massei, L Nicoletti… - International Journal of …, 2014 - degruyter.com,<br>• Simulation as enabling technologies for agile thinking: Training and education aids for decision makers,AG Bruzzone, M Massei, A Tremori… - … of Simulation and …, 2014 - inderscienceonline.com,<br>• Simulation exploration experience: providing effective surveillance and defense for a moon base against threats from outer space,AG Bruzzone, L Dato, A Ferrando - 2014 IEEE/ACM 18th …, 2014 - ieeexplore.ieee.org, |
| Center simulation tools | C/C++, Java, Visual Basic Arena, Horus, WinOp, Modsim III, Taylor II, Proservice, Simulink, Pasion,GPSS/H NeuralWare Pro, JTLSetc.<br>Simulation Hardware<br>3 Hololens, 2 Head Sets for VR, Logistics Laboratory (16 PC), Cocodrillo Labs (4 PC),<br>COCODRIS Mobile Lab (4 PC), HLA Laboratory (6 PC),<br>DIP Labs (3 PC), WILD Mobile Lab (5 Laptops), VR Lab (1 SGI, 1 WS, 6 VRPC), CYBERSAR Lab(9 PC), RAS Lab (8 PC), 1 SPIDER made available at NATO M&S Center |
| Center highlights | Center highlights Scientific Activities<br>The MISS supported the following events:<br>NATO CAX Forum, Roma, Italy , 2021<br>I3M2021 Krakow, , which includes:<br>-The International Workshop on Harbour, Maritime & Multimodal Logistics Modelling and Simulation, HMS, in |

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| | **cooperation with MSC-LES & Simulation Team**<br>**- The International Mediterranean Modeling Multiconference, I3M, in cooperation with MSC-LES & Simulation Team**<br>**-The European Simulation Symposium and Exhibition - Simulation in Industry, EMSS, in cooperation with MSC-LES & Simulation Team**<br>**- The International Workshop in Modeling & Applied Simulation, MAS, in cooperation with MSC-LES & Simulation Team**<br>**EMSS**<br>**HMS**<br>**I3M**<br>**MAS**<br><br>**Exchange Programs in MISS Genoa Center**<br>**MISS Genoa Guests:**<br>**Dr.Bucchianica from Bran New Singapore**<br>**Dr.J.Pernas from University of Coruna**<br>**MISS Genoa Visits**<br>**Dr.Monaci in SBM KL, Malaysia** |