Modelling and Simulation solutions for decision support and training in logistics and transportation

MSC-LES
Modeling & Simulation Center – Laboratory of Enterprise Solutions
http://www.msc-les.org

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Outline

Who We are?

Area of Expertise

Modeling & Simulation

MSC-LES Project and Solutions:
- TRAINPORTS
- CTSIM
- HABITAT
- SEAPORTS
- SOMMA
- WILMA
- MALTA
- PROSIM

References
Who We are?

MSC–LES, Modeling and Simulation Center – Laboratory of Enterprise Solutions is located at DIMEG of University of Calabria

The main goal of MSC-LES is the development of innovative ways to use Modeling & Simulation to achieve new scientific advances in different application areas including Industry, Defense and Supply Chains.

MSC-LES is member of the Simulation Team, a Pool of HiTech Institutions active in M&S, that represents an Excellent Network involving top quality international institutions. MSC-LES is also member of SCS MSNet and other international networks.
People

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**MSC-LES Initiatives**

**MSC–LES, Modeling and Simulation Center – Laboratory of Enterprise Solutions**

**MSC-LES** is member of MS&Net (Modeling & Simulation Network) a consortium of co-operating independent organizations active in professionalism, research, education, and knowledge dissemination in the Modeling and Simulation (M&S) domain.

**MSC-LES** team includes young researchers involved in research and development activities and organization of international events/conferences in the Modeling and Simulation area.

MSC-LES actively cooperates with new companies and spinoff often formed by former students (i.e. CAL-TEK Srl)
Expertise – R&D Areas

**Design of industrial plants and production systems**
- Cost accounting
- Business Plans and investment analysis
- Production systems design
- Plant lay-out analysis and design
- Ergonomic effective design of industrial workstations

**Defense, Military and Homeland Security**
- Synthetic Environments
- Military Logistics
- Simulation Based Acquisition
- Distributed simulation and Interoperable simulation
- High Level Architecture
- Test and Training Instrumentation Architecture
- Human Modeling aspect and multicoalition operations

**Workplace Ergonomic design and security within Industrial Plants**
- Work measurement
- Effective Ergonomic design of industrial workstations
- Risk assessment and security within industrial plants

**Logistics, Transportation & Supply Chain Management**
- Training in marine port environments
- Decision support in Marine port environments
- Supply Chain management based on Modeling & Simulation
- Supply chain security
- Demand forecasting
- Single stage and multi-echelon inventory systems
- Design and management of distribution networks
- Transportation strategies optimization
- Reverse logistics

**Analysis and design of industrial plants facilities**
- Plant facilities design and integration
- Plant facilities parameters modeling and optimization
- Plant facilities reliability and availability analysis
- Plant facilities maintenance
- Global service maintenance
- Plant facilities safety and security
Why Modeling & Simulation?

Internal Complexity → Complex Behaviours

**Simulation:**
- More Efforts
- More Capabilities
- Reusable Model

External Complexity → Many Interaction

- Not Linear Systems
- Not valid Simplification Hypotheses
- Boundary Conditions are Critical
- No Generalization
Simulation Origins

Simulator
Simulator Figurae

Ovid’s Metamorphoses, 11, 634, 8 AD
Simulation is the reproduction of the reality by using computer models.
The simulation allows to build up a **Virtual Environment** and to run dynamic scenarios in order to analyze or optimize the real system.
A simulation project is devoted to develop and use Simulation to solve problems.
Our Simulation Solutions

MSC-LES Project and Solutions:
- TRAINPORTS
- CTSIM
- HABITAT
- SEAPORTS
- SOMMA
- WILMA
- MALTA
- PROSIM
Training in Container Terminals

TRAINPORTS, TRAINing in marine PORT by using Simulation

- Practicing the theoretical concepts that have been taught and shows the consequences of the actions in a very immediate and visual manner
- Providing the instructor with a controlled environment where a large amount of data can be recorded and analyzed to evaluate the trainee’s evolution
- Avoiding the danger of an inexperienced user manipulating the real machine in the working environment
- Reducing the cost associated to training
- Providing the trainee with the possibility of working in any desired conditions (i.e. arbitrary weather conditions)
Training in Container Terminals

TRAINPORTS, TRAINing in marine PORT by using Simulation

Operators and workers are required to have deep knowledge and special experience to deal correctly and safely with advanced machines for containers handling.

The Straddle Carrier Simulator recreates the operations devoted to move containers in the yard area and from/to quay cranes. The Straddle Carrier is equipped with a virtual cockpit containing all the straddle carrier commands.

The trainee has the possibility to change different views: inside the cockpit (to have the sensation to be within the straddle carrier), outside (to see the whole straddle carrier from different points, top view, lateral view, etc.).

By using an external steering wheel, pedals and joystick the trainee can move and use the straddle carrier.
The Quay Crane Simulator recreates the operations devoted to move containers from the ships to the berth and vice-versa.

Used to select training candidates, train new operators, evaluate and improve operators' skills.

Accurate in terms of lights, steering, indicators and pedal controls to provide accurate behavioral realism.

Quay Crane equipped with telescoping jib and a variety of loads and hook blocks. Instruments reading: boom angle, length, height, radius and quadrant, simulated load moment.

The Forklift Simulator can be used to investigate supporting security procedures within container terminal.

The Truck Simulator is designed to provide an excellent training system for heavy vehicle operators and allows the trainee to experience and get familiar with engine dynamics, transmission dynamics, brake dynamics and steering dynamics.
CTSIM - Car Terminal SIMulation based serious game for ro-ro operations

Training in Car Terminals

Three interoperable simulators

Ship Simulator

Operator Simulator

Vehicle Simulator
Training in Car Terminals

CTSIM - Car Terminal SIMulation based serious game for ro-ro operations

The Vehicle Simulator

- The Vehicle Simulator recreate the standard operation of various types of vehicles to load and unload from mother-ships and feeder.

- It can be controlled by specific hardware interfaces (eg. Steering wheel, pedals, dashboard, etc.)

- An immersive visualization system is included, it is based on multiple screens and an integrated sound system in order to guarantee for the user the viewing of the external port environment (as well as with the real vehicle), and the feeling of being in the real port.
CTSIM - Car Terminal SIMulation based serious game for ro-ro operations

The Ship Simulator

- Allows simulating two types of vessels devoted to transport cars and buses: Ro-Ro car/truck carrier for long transport routes (international and/or intercontinental) and Ro-Ro feeder.
- Has the opportunity to select climatic conditions such as wind, visibility, rain and sea state.
- To recreate different scenarios of training were modeled different layouts of bridges, ramps, linear meters of lanes, etc.
- It is equipped with multiples views, to facilitate the training of different types of operators.
The Operator Simulator

- Simulate all the visuals instructions for the movement of vehicles carried out by Marshalls (Parkers).
- The simulator include a graphic user interface MIL (Man in the Loop) with both a computerized console and a hardware for the variation of the basic parameters (type of display, vantage point of the operator, etc).
- The main purpose is for training and exercise of Marshall (Parkers)
Training On Board Ship

HABITAT Training and Exercise System

Tugboat Simulator
- 1-2 Tugboats
- Interaction with ships (by rope or pushing)

Ships Simulator
- Tanker (Esso Osaka)
- Containership (Kriso)
- Bulk Carrier (Diamond 34 series)

Weather/Marine condition
- Weather Conditions (i.e. rain)
- Wind intensity
- Sea state

Control Tower
- Control tower different views
- Communication with ships and tugboats
- Recreating ships traffic in the port area

Scenario Definition

Ports
- Port of Salerno
- Port of Livorno
- Port of Gioia Tauro

Single/Multi training
- Stand alone ship simulator;
- Stand alone control tower simulator
- Stand alone tugboat simulator
- Interoperable Simulator: all possible combinations (ship-tugboat-control tower)
Training On Board Ship

HABITAT Training and Exercise System

The Port of Gioia Tauro

- 67,000 yards slots,
- 2350 reefer plugs,
- Handling capacity: 4,200,000 TEU per year,
- Deep water berths: from 12.5 meters up to 18 meters,
- Meters of quays (used by Medcenter Container Terminal SpA): 3,395 meters,
- Meters of wharf (used by Medcenter Container Terminal SpA): 3,395 meters (used by BLG Automobile Logistics Srl): 384 meters,
- Quay Cranes: 22 gantry cranes, 3 mobile cranes,
- Yard Equipment: 125 Straddle Carriers, 13 Reach Stackers,
- Adjacent rail services.
Training On Board Ship
Training On Board Ship

HABITAT Training and Exercise System

The Port of Salerno

- Entrance channel
  - 280m large;
  - 13m deep;
- Evolution area:
  - 550 m diameter and 12 m deep
- 4 tugboats, 5 expert pilots with 2 equipped pilot-boats and 10 mooring operators with 2 equipped motorboats.
- The port area includes the following quays:
  - Quay of Ponente, length 563m, dockings n. 22-24;
  - Rosso quay, length 226m, dockings n. 20-21;
  - Trapezio quay, length 890m, dockings n. 13-19;
  - Ligea quay, length 250m, dockings n. 11-12;
  - 3 Gennaio quay, length 446m, dockings n. 7-10;
- For large boat it is mandatory to be assisted by at least two tug boat during steering activities
Training On Board Ship

HABITAT Training and Exercise System
HABITAT Training and Exercise System

The Port of Livorno

- capacity of around 30 million tonnes of cargo and 600,000 TEU's
- the only in Italy and the second in Europe with liquefied natural gas (LNG) terminal
- 800,000 square meters (2,500,000 square meters considering surrounding areas)
- 11 km of quay
- 100 docking points
- maximum deep water 40 feet
- strategic connections to railway and to major road
- strategic hub for both Italian and European freight traffic
Training On Board Ship

HABITAT Training and Exercise System
HABITAT Training and Exercise System

Training On Board Ship

Different available viewpoints:
• inside the bridge
• outside the ship (therefore it is possible to see the whole ship from different points of view)
• from control tower
Training On Board Ship

HABITAT Training and Exercise System

- Weather Conditions (i.e. rain)
- Wind intensity
- Sea state
SEAPORTS is a simulation model able to recreate all the port processes and activities. It is equipped with a dedicated GUI that can be used to change critical factors and see their effects on port performances. By using SEAPORTS it is possible to:

- Review, test and improve processes and activities
- Carry out what-if analysis changing critical parameters (i.e. ships inter-arrival times, number and type of container handling equipment, number of operators, etc.)
- Yard planning and management
- Design and re-engineering of security procedures and infrastructures
Define your own supply chain in terms of number of echelons, number of plants/suppliers, number of distribution centers, number of stores, type and number of items, etc.

• Carry out what-if analysis on different scenarios (i.e. an additional distribution center?)
• Evaluating for each node different inventory control policies and demand forecasting methodology
• Monitor during the simulation the evolution of inventories, delivery times, costs, etc.
WILMA is a warehouse simulator able to recreate all the process and activities of a real warehouse. It gives the possibility to change multiple parameters (i.e. time windows for trucks arrivals, penalty costs, handling equipment efficiency) and see the effects on different performance measures (i.e. cost for each moved pallet/package, service/waiting times, resources utilization levels, etc.).
The project presents a three-dimensional model capable of reproducing in the virtual environment a real supermarket. The interactivity between the virtual model and the user is carried out by using different functions: the user can easily search items and obtain information related to the products such as brand, quantity, description etc.. In addition, the user can choose different types of movement like plane or fly.
Virtual Prototyping and Store Design
Store Remote Monitoring & Control by On-line Simulation
Virtual Reality Totem
Web Virtual Reality Store

This project proposes an innovative integration of Virtual Reality Environments with Simulation in order to support dynamic simulation of supermarket and retail stores; the tool is a technological demonstrator for understanding the potentials of Virtual Reality and Modeling & Simulation based approach in the following domains of applicability:

- Virtual Prototyping and Store Design
- Store Remote Monitoring & Control by On-line Simulation
- Virtual Reality Totem
- Web Virtual Reality Store
MALTA, Modeling and Analysis of Ligurian Transportation Activities

MALTA is the application of simulation to recreate the transportation network of a large scale retail company operating in Liguria. It is possible to:
- Test different options for transportation from suppliers to distribution centers and from distribution centers to stores (i.e. each distribution center serves the nearest store and a shuttle service is used to fill the gap between stores)
- Performance measures include all the costs (such as fuel, personnel, highways fees, trucks maintenance, tickets, etc.)
PROSIM is the application of simulation to recreate the pharmaceutical distribution in Calabria. It is possible to:
- define specific multi drop routes;
- evaluate the impact on the service levels provided to pharmacies when new nodes (pharmacies) are added to the route considered
- carry out routes optimization by using genetic algorithms or Ants Theory
MSC-LES, as part of the *Simulation Team* supports the organization of different International Conferences and Courses, including:


- The Professional M&S Courses, [www.msc-les.org/mscourses](http://www.msc-les.org/mscourses)

- International conferences supported by MSC-LES: [www.msc-les.org/conf](http://www.msc-les.org/conf)
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