

Net-WMS: Towards Integrating Virtual Reality and Optimization Techniques in a new generation of Warehouse Management Systems

Objectives

Net-WMS proposes interactive optimization tools and prototype software to form the basis of future Warehouse Management Systems, through the integration of various decision-making technologies:

- generic 2D/3D and higher-dimensional placement constraint solvers
- visualization and interaction with the solvers in virtual reality
- knowledge modeling with business rules

Expected outcome

Scientific results

- Algorithms for the solution of placement problems in space and time
- Expression of constraint optimization problems with a language of business rules
- Control of optimization tools by interactions in virtual reality

Technological contribution

- A set of J2EE interfaces for interoperability and mobile services, enabling communications between planning components across a network,
- A mobility interface, allowing remote users (e.g. truck drivers) to report planning changes,
- New interactive modules combining Constraint Programming, Rule Programming and Virtual Reality
- Extensions to constraint programming and rule programming tools (CHOCO, CHR, Drools)

Prototype software

- A packing modeler and solver based on optimization techniques and interactions in virtual reality,
- A palletizing tool using optimization techniques
- A dispatcher including the virtualization of truckload

First results

A generic geometric constraint kernel (N. Beldiceanu, M. Carlsson, R. Sadek)

- For the placement of k -dimensional objects in space and time
- Objects composed of a set of parallelepipeds
- Examples of constraints: NonOverlapping, Included, Visible
- Propagation using the sweep technique
- Handles 10^4 objects in 2, 3, or 4 dimensions
- First implementations available in SICStus and CHOCO

Compilation of business rules to constraint programs (J. Martin)

- A hierarchical knowledge representation language for Packing Problems
 - Business Rules (user level)
 - Placement Constraints (intermediate level)
 - Geometrical Constraints (concrete level)
- Concrete level corresponds to a SICStus CLP(FD) program
- Compilation done by Constraint Handling Rules



Applications

Packing for completely-knocked-down transportation (PSA)

- Hierarchical packing of parts into containers for overseas transportation
- Complex requirements expressed as business rules

Re-design of the means-of-picking (FIAT)

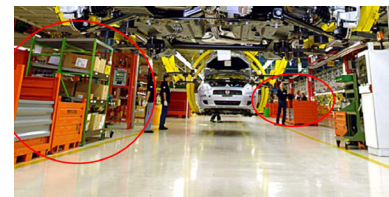
- Choosing or designing the best suited container
- For car parts with complex 3D shapes

Re-design of the line-side storage area (FIAT)

- Warehouse design with a large choice of shelf structures
- Minimizing the distance between storage and usage location

Scheduling of the picking activities (FIAT)

- Scheduling the material replenishment from the warehouses to the line
- Coupled with the placement of items in the wagons



Fact sheet

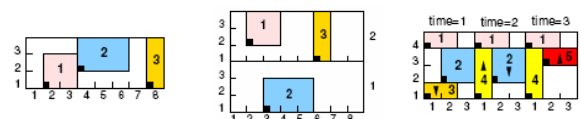
Full name: Towards Integrating Virtual Reality and Optimisation Techniques in a New Generation of Networked Businesses in Warehouse Management Systems under Constraints

Project type: EC ICT STREP
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Participants:

- Project management : ERCIM
- Industrials: Peugeot Citroën Automobiles (France), CRF/FIAT Group (Italy)
- Research Institutes : INRIA and CEA (France), SICS (Sweden)
- Academics : EMN (France)
- Technology SMEs : KLS Optim (France), Mind2Biz (Turkey), WideScope (Portugal)

Website: <http://net-wms.ercim.org/>



Three applications of the geometric constraint kernel: Placement of objects in a single container (A), in multiple containers (B), and over consecutive time slots (C)

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