

D^2CTS : a Dynamic and Distributed Container Terminal Simulator

S. Balev, F. Guinand and G. Lesauvage



Unité de Formation et de Recherche des Sciences et Techniques

Laboratoire d'Informatique et du Traitement de l'Information et
des Systèmes



September 12th-14th, 2011

Plan

- 1 Introduction and Objectives
- 2 Modelling
- 3 Retrieving and structuring data
- 4 Simulated optimization problems
- 5 Conclusion

Plan

1 Introduction and Objectives

2 Modelling

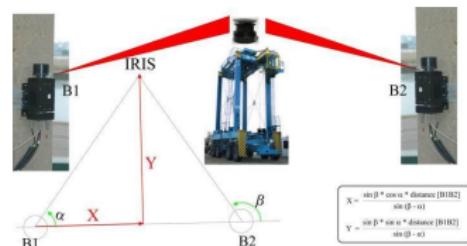
3 Retrieving and structuring data

4 Simulated optimization problems

5 Conclusion

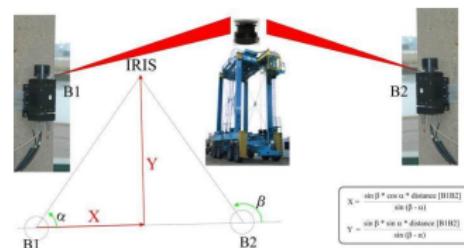
The CALAS project

- CArrier LAser tracking
- Companies :
 - LDTT
 - EADS/Astrium
- Laboratories :
 - LMAH
 - LITIS



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CALAS Objective:

To know the state of the terminal, in real time, for both containers and handling trucks location

D^2CTS

Dynamic and Distributed Container Terminal Simulator

Objectives:

- Emulating a container terminal in both its structure and its dynamics

D²CTS

Dynamic and Distributed Container Terminal Simulator

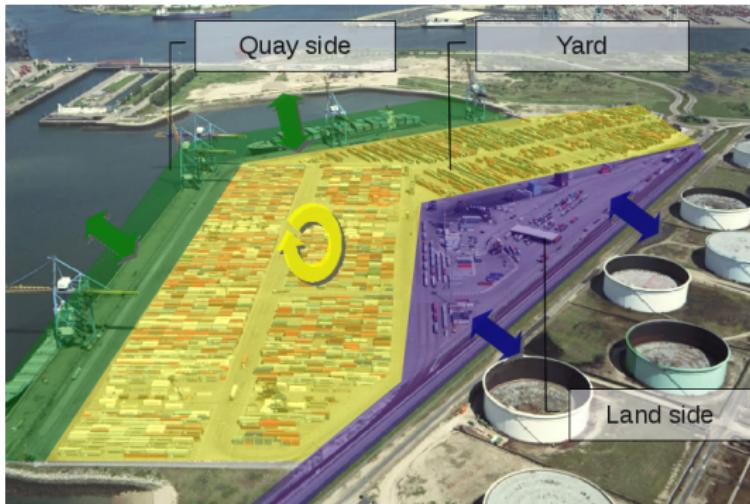
Objectives:

- Emulating a container terminal in both its structure and its dynamics
- Performing various optimization algorithms in a realistic environment for testing their relevance

Plan

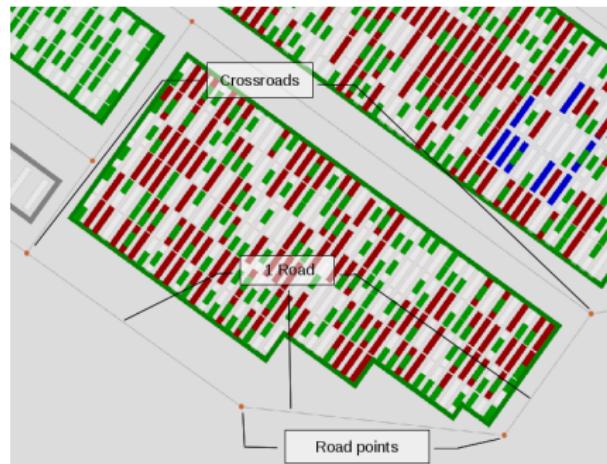
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Test Case : Terminal de Normandie (Le Havre, France)

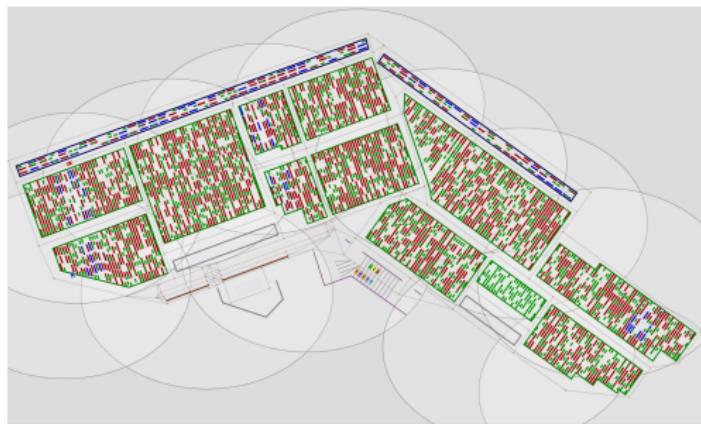


Road network

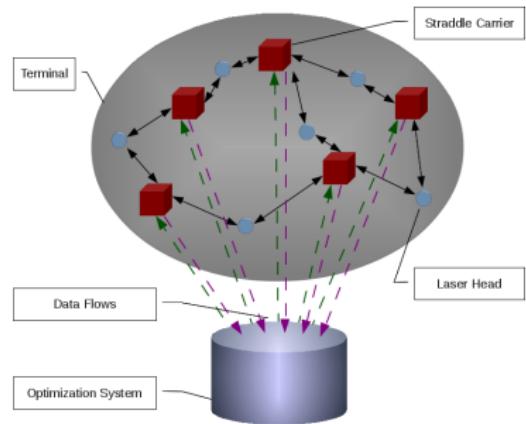
- Crossroads
- Roads
- Road points
- Lanes



Laser localizing system



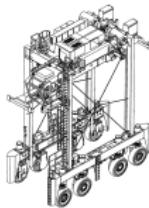
Laser localizing system modelling on the Terminal de Normandie



*Communications between the straddle carriers
and the optimization system*

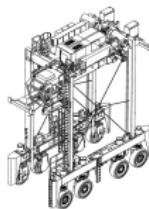
Mobility

Only straddle carriers mobility is handled by the simulator for the moment



Mobility

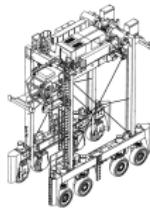
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- on roads: straddle carriers can pass and overtake each other

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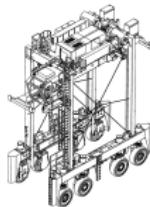
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- on roads: straddle carriers can pass and overtake each other
- on lanes: straddle carriers can neither pass nor overtake each other

⇒ Lanes are modelled by FIFO arcs

Time modelling

- Discrete time
- Step size setted before starting simulation

Video : time control in D²CTS

D²CTS

The events

- Mission event: arrival, cancellation, delay

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- Vehicle arrival/departure

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- Straddle carrier failure:
 - Physical failure (motor, spreader or both) video
 - The driver does not choose the mission proposed by the scheduler
 - The driver does not follow the computed route

Video : Straddle Carrier Failure

D²CTS

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Video : Laser Head Failure

D²CTS

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Retrieving data

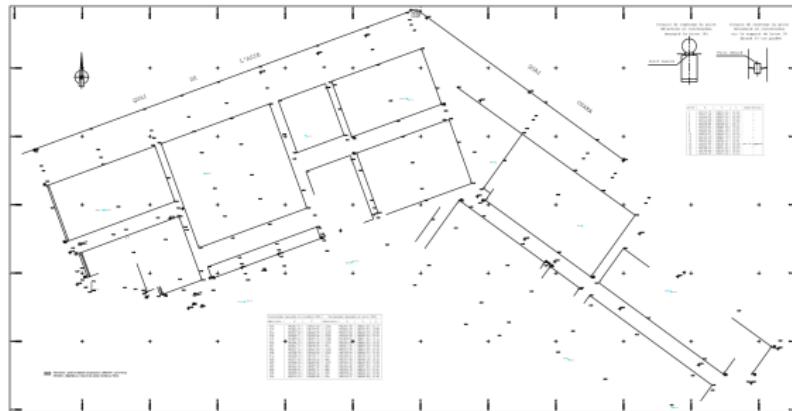
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Retrieving data

- Crossroads and lanes boundaries coordinates
- Roads and lanes description

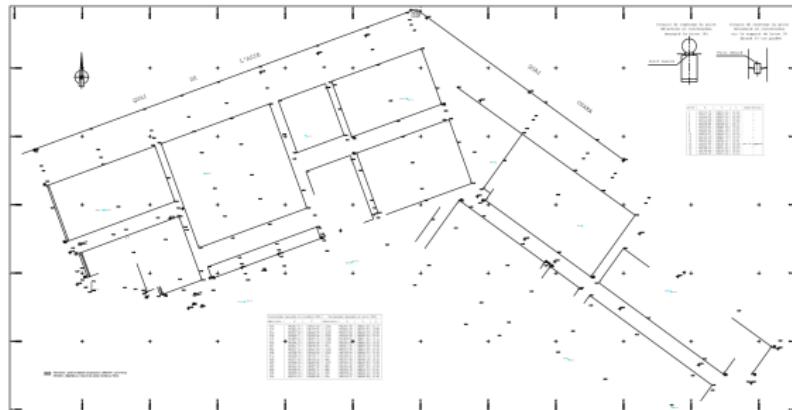
Retrieving data

- Crossroads and lanes boundaries coordinates
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- Blocks description (ship side, land side, yard)



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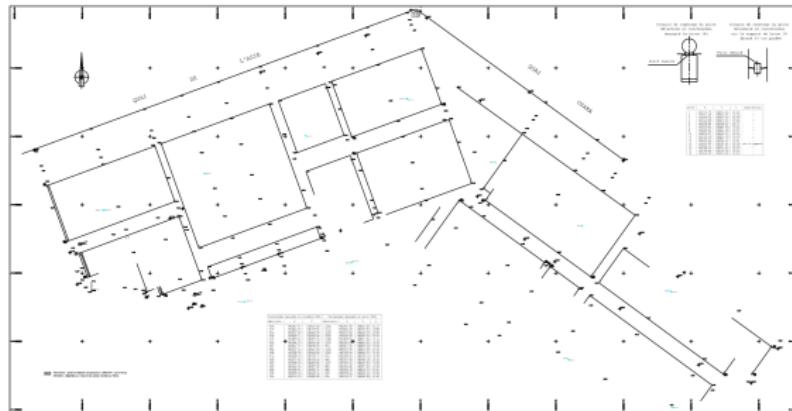
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- Straddle carriers models characteristics

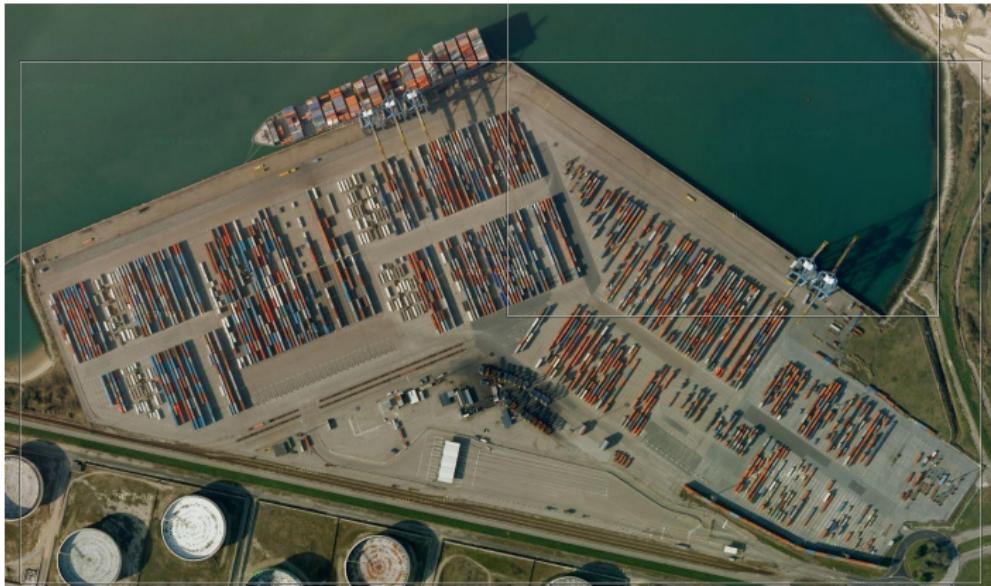
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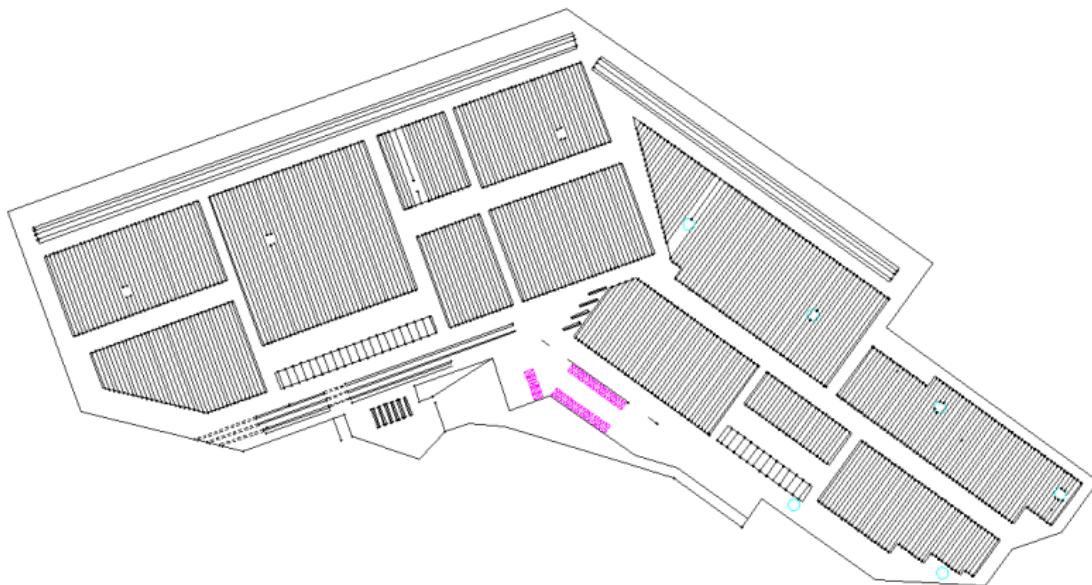
- Straddle carriers models characteristics
- Laser system data

Retrieving data (2)



Terminal de Normandie, Le Havre, France (wikimapia.org)

Retrieving data (3)



Detailed plan of the *Terminal de Normandie*, Le Havre, France

Data Structuration

XML formalization

- Simplicity
- Clarity of the data
- Personalization
- Easy navigation

```
<event time="0:20:0" type="vehicleIn" lanes="train1_1/4,train1_4/4">
    <container id="SZWU 075947 3" teu="2.0">
        <containerLocation pave="train" lane="train1_1/4" slot="train1_1/4-0" level="0" align="origin"/>
    </container>
    <container id="GPMU 632388 2" teu="1.0">
        <containerLocation pave="train" lane="train1_4/4" slot="train1_4/4-1" level="0" align="center"/>
    </container>
</event>
```

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Terminal Configuration

Objective :

Testing the structure of a terminal

Terminal Configuration

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Measuring the impact of the terminal architecture on:

Terminal Configuration

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Measuring the impact of the terminal architecture on:

- the exploitation costs

Terminal Configuration

Objective :

Testing the structure of a terminal

Measuring the impact of the terminal architecture on:

- the exploitation costs
- the quality of service

Dangerous containers positioning

Objective:

Finding a matching location for a container

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Finding a matching location for a container

The problem consists in choosing a location reducing the handling distances and complying with the safety standards

Dynamic scheduling

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Modeled problem:

Dynamic version of a missions scheduling and allocating problem

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- Roads : non FIFO arcs
- Lanes : FIFO arcs with unit capacity
- The speed of a straddle carrier depends on its location

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To minimize the travel distance of the straddle carriers to reduce the exploitation costs

Routing problem on a container terminal:

- Roads : non FIFO arcs
 - Lanes : FIFO arcs with unit capacity
 - The speed of a straddle carrier depends on its location
- ⇒ To minimize the travel time to reduce the costs and to maintain a sufficient quality of service

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Conclusion & Outlook

- Validation process

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 - collect data (container terminal architectures, data sets)
 - test optimization algorithms (missions scheduling, vehicle routing)

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