The localisation of freight wagons on marshalling yards

P5 presentation | Hester Willems | 25 June 2015
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• Problem
• Result
• Road to the result
  • Research questions
  • Result literature study
  • Characteristics & processes
  • Tests
• Conclusions, applicability & future work
Problem description

- Location of freight trains not known: Problem for efficiency & use of rail transportation: "... There are also a lot of complaints about lacking service on the rail. According to Sitskoorn, a freight train can easily be lost for a week. 'You don't believe this in the time of GPS, but it is the case..."

- Unsafe situations, example fire on marshalling yard Kijfhoek
Problem description
Problem description
Result: System using GPS with enhancements that can determine the track and order of the wagons.
To what extent is it possible, using current and affordable positioning techniques, to localise freight trains on marshalling yards in such a way that it can be determined on which shunting track the coach is located and what the order of the wagons is?
1. What techniques could be used for the localisation of freight wagons and what are the advantages and disadvantages?
2. What localisation technique would be optimal to use in this particular case, based on its performance parameters?
3. What would be the best set up to use for the chosen method?
4. Does the method and system architecture work? Does it generate the expected results?
5. On what scale (area, track, exact location) can freight wagons be found using the system?
Methodology

- Literature study
- Method of positioning
- Input stakeholders

Develop processes → Formulate characteristics → Test whole system in real test → Analysis & validation → Small tests of parts of the system
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Contents

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GPS/GNSS
Literature study

Method of positioning

Input stakeholders

Develop processes

Formulate characteristics

Small tests of parts of the system

Test whole system in real test

Analysis & validation
Marshalling yard characteristics

- Stationary vehicles
- Vehicles on marshalling yard usually stay on the same spot for the largest part of their stay

- Rail network
- The wagons are on the rail network, this network can be seen as an extra reference system for the location of the wagons

- Order of the wagons
- For analysis purposes, to see how accurate the distance between two subsequent wagons is
- If analysis goes well, order of wagons can be determined based on distances

Hardware
Marshalling yard characteristics

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GeoEvent Extension
Characteristics & Processes

Marshalling yard characteristics

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Test setup
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Error:
- One to two
- Two to three
- Three to four
- Four to six
- Six to one

Raw data

Legend:
- May third
- May fourth
- May ninth
- "Railnetwork"
- Basemap
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Average – All sensors
Marshalling yard characteristics

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Average – Sensor 3
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Third of May

- Distance (m)
- Time (min.)
- Error one to two
- Error two to three
- Error three to four
- Error four to six
- Error six to one

Ninth of May

- Distance (m)
- Time (min.)
- Error one to two
- Error two to three
- Error three to four
- Error four to six
- Error six to one

Average - Sensor 3
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Average matched
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X axis = time (minutes)
Y axis = rail number

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Average matched

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Sensor 2

Sensor 3

Sensor 4

Sensor 6
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![Graphs showing distance over time for Third of May and Ninth of May with different error ranges.](chart.png)
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X axis = time (minutes)
Y axis = rail number
Order of wagons
Test conclusions

- Previous measurements improve result (outliers removed)
- Correctly matched in 51% of cases in average calculation, 65% after median
- Median after an hour and a half always matched correctly
- Determining order based on bearing and distance is possible if sensors couple of meters apart
Conclusions sub questions

1. What techniques could be used for the localisation of freight wagons and what are the advantages and disadvantages?
2. What localisation technique would be optimal to use in this particular case, based on its performance parameters?
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To what extent is it possible, using current and affordable positioning techniques, to localise freight trains on marshalling yards in such a way that it can be determined on which shunting track the coach is located and what the order of the wagons is?
Applicability

- Previous measurements improve result (outliers removed)
- Correctly matched in 51% of cases in average calculation, 65% after median
- Median after an hour and a half always matched correctly
- Determining order based on bearing and distance is possible if sensors couple of meters apart
Future work

• Previous measurements improve result (outliers removed)

• Correctly matched in 51% of cases in average calculation, 65% after median

• Median after an hour and a half always matched correctly

• Determining order based on bearing and distance is possible if sensors couple of meters apart
Questions?