Route Optimization for Offshore Maintenance Tasks & Case Study

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Problem Definition – Daily Route Optimization

- x-coordinate in km
- y-coordinate in km

- running turbines
- failed turbines

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Problem Definition – Daily Route Optimization

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State of the Art

• **Routing Algorithms:** [1] [2]
  - high computation times

• **Simulation Models:** [3] [4]
  - no optimisation

• **Reality:**
  - experience based decisions
Target Definition

• **Routing optimization** in reasonable computation time

• Implementation in simulation model

• **Compare logistic strategies** in case study

• **Evaluate possible improvements** (short-term/long-term)
Method - Decomposition

Downtime losses are higher than CTV fuel costs

1. Optimize Schedule
   • Time-based availability
   • Energy losses

2. Optimize Routes
   • Travelled distance CTVs
   • Fuel costs
Case Study – 8 Logistic Strategies

- **Simulation period**: 20 years
- **Windfarm**: 80 turbines
- **CTVs**: 1-3 CTVs
- **Teams per CTV**: 1-4 Teams
Results – Time-Based Availability

days of operation

time-based availability in %
Improved Strategy – Seasonal Behavior

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Detailed Evaluation – Winter Storm

work load of technicians in %
time-based availability in %
wind speed in m/s
years of operation

work load of technicians
wind speed on hub height
time-based availability

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Detailed Evaluation – Winter Storm

1.5 m
2.0 m
2.5 m

Time-based availability in %

Wind speed in m/s

Years of operation

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Conclusions

• **Route optimization + simulation model**
  • decomposition, optimization rules, iterative calculations
  • computation times: 1h – 1day for 20 years simulation

• **Comparison of logistic strategies**
  • in terms of costs, time-based availability, energy output, work load…

• **Detailed analysis**
  • short-term strategy improvements
Thank You For Your Attention

Any questions?

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References


