Man-Machine Interactions and their Consequences on future Forestry Activities

UNECE COFFI 2018, November, 6th, 2018
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What is the difference between the two videos?

Robotics
eRobotics

The Institute for Man-Machine Interaction

- Institute for Man-Machine Interaction
  - Faculty for Electrical Engineering, RWTH Aachen University
- founded 2006
  - by Prof. Dr.-Ing. Jürgen Roßmann
- Currently about 50 employees
  - Including 20 scientific employees
- Our Goal
  - Building the scientific foundation for eRobotics

From Visualization towards Virtual Testbeds and Simulation-based X

Visualization / Animation
  - Static visualization of realistic models, enhanced by predefined animation

Simulation
  - Detailed analysis of single individual aspects including physics

Virtual Testbed
  - Analysis of the complete system within its environment, integration of the model, simulations, and data processing

Simulation-based X
  - Engineering Control Optimization Reasoning User Interfaces
**Digitalization**

- **Digital Technologies change the world – fast**
  - 2005: Visitors of the Vatican after the death of pope Johannes Paul II
  - 2013: Visitors of the Vatican after the retirement of pope Benedict XVI

- **Perfect?**
  - Cars are now perfect. They do not need further improvement.

- **"If I had asked people what they wanted, they would have said faster horses."**
  - Henry Ford
Innovation by stepwise advancement?

Disruptive Developments are not new:
Refrigerator vs. „Block of ice in the Basement“
Pflough vs. Spade
Cellphone vs. Phonebox
CAD vs. Drawing Board
etc.

The Invention of Electrical Power was a disruptive Development!

Everythings is fine!

Comfort Zone-Dilemma: Actually, everything is fine.

How do major companies handle disruptive changes?

Example: Forest Surveyor
Sustainable Usage of the Forest

We need a precise inventory of the forest.

Key Idea: Do not harvest more than the timber volume that grows back.

Sustainable Usage of the Forest

We need a precise inventory of the forest.

Traditional forest surveying

1) Perform an angular sample count to determine the basal area of all trees of the unit

2) Determine top or mean height of the trees
1. Determine the age of the trees

2. Estimate the timber volume by using the yield tables

3. Update the map of the unit

4. Take the collected data to the office

   This has to be repeated every seven years for each forestry unit.
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Forest Surveyor 2.0
Image: A. Böhm

Remote Sensing

LIDAR point clouds
Point Clouds in Testareas provide a detailed view of the forestry unit.

From Testareas to States
- Heterogenous Pointcloud
- 250 Billion Points
- 1-10 Points/m²
- 32.000 km²
- Several Flight Campaigns
- Different Years


State North Rhine-Westphalia
Open data in North Rhine-Westphalia

Since January 1st, 2017, North Rhine-Westphalia provides open-data. All geodata collected by the state are now available for free for everybody.

<table>
<thead>
<tr>
<th>Area</th>
<th>Coordinates</th>
<th>Points/m²</th>
</tr>
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<tr>
<td>Near Espeikamp</td>
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<td>4</td>
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<td>Near Bad Münstereifel</td>
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</table>

Species Distribution

Calculate the tree species distribution from the classification map.

Dominant Height

For each species: Weighted average of the highest points for raster cell.
By using multitemporal LIDAR, the quality of the unit can be addressed.

Calculate the correlation between Canopy Coverage and Yield Factor.
Forestry Communication Networks

ClusterWIS
- Networked Forest Information and Management System
- Decentralized Information Structure
- Standardized Communication Objects
- Open Interfaces
- Software Services
- Communication structure for individuals in the forestry sector

Applications
- Forest growth simulation based on individual trees or representative units.

Applications
- Visualizing the effect of different harvesting strategies.
"Forestry 4.0" is not alone!

Farming 4.0

Bauindustrie 4.0

NRW 4.0

Smart Grids

Smart Health

Smart City

Smart Mobility/Smart Logistics

Smart Port

"Forestry 4.0" is not alone!

A comprehensive DIGITAL TWIN of a forestry unit for example could:

- STORE the inventory data of the last years.
- SIMULATE the development within the next years for several harvesting strategies.
- SENSE the local growth conditions permanently.
- COUNSEL workers, machines, … for the optimal planning of harvests in consideration of required measures of nature conservation, safety measures, …
- EXPLAIN tourists, where to find unique trees or bird species
- INITIATE required harvests and strategies under consideration of its current state and the market situation
Digital Twins are Basis for the Digitalization and Result of the Digitalization – at the same Time!

Forestry Networks

Communication Network

Value added Chains and Networks

Physical Asset

Digital Twin

Digital Twins are Basis for the Digitalization and Result of the Digitalization – at the same Time!
Conclusions

• change towards a network of humans and digital assets
• change in the requirements for personnel
• change in the workload and the tasks

"Decent Jobs"

• work in a modern, interesting and demanding environment
• jobs require a qualification => educated jobs
• a huge supply chain relies on forestry => sustainable jobs

Thank you!