SLOPE: A 3D forest virtual system to support harvesting operation in mountain areas

D. Magliocchetti, F. Prandi, G. Panizzoni, D. Lotto, R. De Amicis
Outlook

• Introduction
• 3D Forest Virtual System
• Technology overview and features
• Computer aided cableway planning
• Conclusions and future works
Introduction

- Forests in mountainous areas: 23% of the Earth
- Mountain forest management & production ≠ industrial management
- Difficult mountain conditions
  - Steep terrain
  - Limited accessibility
  - Long vegetative succession
  - Hydro-geological constraints
- Manual operations:
  - Tree marking
  - Felling
- Increased operation costs
The SLOPE project

“Integrated processing and Control Systems for Sustainable Production in Farms and Forests”

SLOPE project aims to optimize forest production building a 3D forest model to support the entire wood process, from tree RFID tagging to cut and de-branched logs ready for the sawmills.
3D Forest virtual system goals

Develop methodologies and tools to fully describe and view terrain and stand characteristics to support forest production.
Data integration

Using the remote data (Satellite, UAVs orthophotos and derived digital surface model) combined with on field information (TLS), each single tree feature will be segmented including its deducted geometric properties.
3D Virtual forest planner

WebGL & HTML5 technology
- Supports almost any browser
- Easy integration on third-party services
- Powered by GeoBrowser3D Virtual Globe

Wide geographical data support
- DSM & DTM
- WMS Imageries
- Real-time Sensor Observation Services
- KML/KMZ Google Earth datasets
- 3D Object rendering

From experts to the experts
- Forest operator & planner, cableway & truck operators etc.
- Several development iterations

3 Main Modes: analytics, operation, forest
Analytics mode

Geometrical and geophysical information visualization:
- High Resolution Digital Surface Models
- Open geographical data (e.g. cadaster, roads, etc.)
- Satellite and aerial imageries (NIR, RGB, et.)
- Points of interest
- Surface and distance measurement
- Slope analysis
Operation mode

Forest operation planning tools:
- Cableway deployment planning
- Working area setup
- Tree felling and transport monitoring
- Weather forecast
Forest mode

Forest inventory inspection:
• Single Tree and Stem visualization
• Physical properties inspection (height, diameter, species, etc.)
• Virtual marking support
• Aggregated data for specific areas
Computer aided cableway planning

Cableway setup is a complex and time consuming:

• Morphological issues
  - Canopy height, forest density, marked trees, terrain height

• Machine limitations:
  - Cable length, inclination, payload, cable tension, covered area

• Human costs:
  - 2 Days for cable yarder deployment
  - 1 Day for each intermediate pylon

Main goals:
• Minimize deployment times and costs (no pylons)
• Maximize cable line coverage area
Main planning steps:

1. Take measures: draw polygonal area lines to detect landing zone or other operational areas

2. Assess cable launch feasibility [experimental]

3. Draw cable lines:
   1. Add at least 2 pylons by click or coordinates
   2. Check constraints
   3. Modify cable line (adjust tension, add/remove/move pylons)

4. Export data
Computer aided cableway planning

Take measurements
Computer aided cableway planning

Rope launcher simulation
Computer aided cableway planning

Cable Crane Setup Simulation
Computer aided cableway planning

Cable Crane Setup Simulation
Computer aided cableway planning

Export deployment plan
Video

www.slopeproject.eu
Conclusion and Future works

Tool for visualization and planning of harvesting operation in mountain forests:

- Web based and cross platform
- Combines 3D Visualization with GIS data
- High level of interaction
- Deeply connected with a forest information system to track the entire forest production

Integration not completed

- Still a work in progress
Thank you for your attention

DANIELE MAGLIOCCHETTI

daniele.magliocchetti@graphitech.it

Fondazione GraphiTech
Via Alla Cascata 56c
38123 Trento (ITALY)

Phone: +39 0461.283393
Fax: +39 0461.283398

www.slopeproject.eu
www.graphitech.it
www.geobrowser3d.com