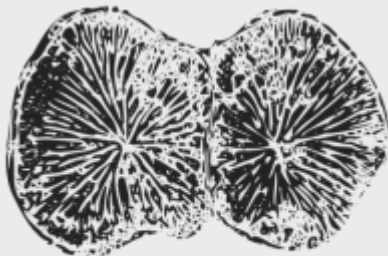


Automatic timber-tracking and volume estimation using 3D imaging sensors & Gen2 RFID technology



AITOLOS

Cross-border collaboration to fight illegal logging and timber trade

Radio-
Frequency
Identification



RFID

Wireless Engineering

🌐 www.trinitysystems.gr

📧 info@trinitysystems.gr

☎ +30 2310 473 470

About Us



- ⊙ Engineering SME > specialized turn-key ICT solutions and system integration services to the enterprise sector
- ⊙ Spun-off in 2006 by doctorate students of the Aristotle University, through the entrepreneurship competition “Innovative Ideas” (1st prize for best business plan)
- ⊙ Located in Thessaloniki, Greece
- ⊙ Specialization (H/W & S/W):
 - Wireless engineering, RFID, IoT & RTLS
 - Analog/digital electronics design
 - IT & Applied Signal Processing
 - Concept/Specs/Prototyping/Testing/Product



Project requirements



- ⊙ Pilot evaluation of new technologies for
 - efficient timber supply-chain management
 - timber traceability (origin certificate)
 - fighting illegal logging
- ⊙ Automatic Vehicle Identification
 - Trucks passing through a portal (UHF Gen2 RFID)
 - Autonomous and automated (no-user intervention)
- ⊙ Timber-tracking
 - Only for technical wood (UHF Gen2 RFID)
- ⊙ Load Volume Estimation
 - 3D-depth sensors & image-processing algorithms

Implementation challenges



- ⊙ Robust construction (all-weather/mountain sited)
- ⊙ Solar power-supply & power management
 - Battery life
 - Sensors-triggered events (idle-mode)
- ⊙ No ground cell-coverage
 - High-gain directional 3G antenna
- ⊙ Equipment grade at least IP65 (outdoor usage)
- ⊙ Anti-vandalism precautions
 - Exposed equipment only if absolutely necessary

Field technologies at a glance



- ⊙ Solar-powered portal (PV panels, power-tracking charger)
- ⊙ Doppler radar detector (vehicle proximity trigger)
- ⊙ Photo-electric sensors (triggered events)
- ⊙ 3G cellular networking
- ⊙ RFID UHF Gen2
 - Automatic vehicle identification (AVI)
 - Timber-tracking
- ⊙ 3D depth cameras
 - Load-volume measurement (LVM)
 - Customized image-processing algorithms

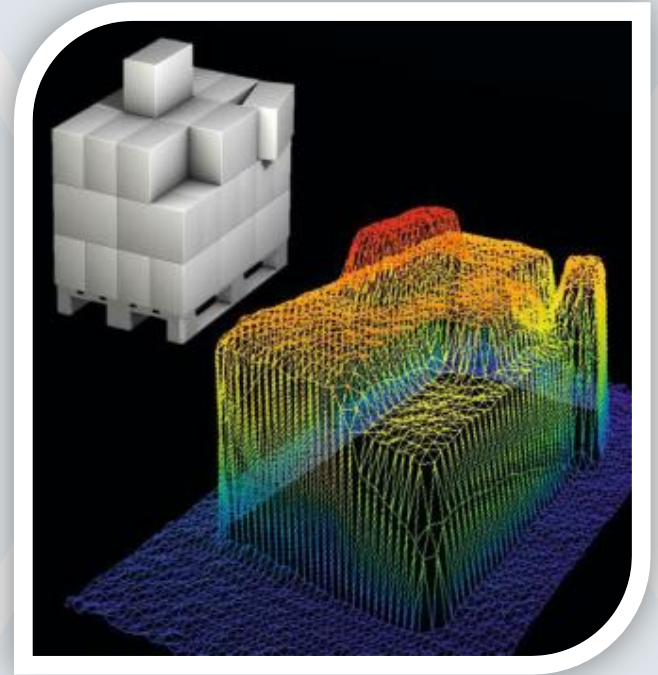
RFID technology components



3D image sensor technology



- ⊙ 3D PMD sensor
- ⊙ ToF (time-of-flight) camera
- ⊙ 3.200 infrared beams for illuminating the object
- ⊙ Redundant processing information (2 cameras & moving object)



3D image processing techniques



- ⊙ Challenge: estimate load-volume from 3D point-clouds
- ⊙ Raw data (depth/distance):
 - Consecutive camera frames 64x50px point-clouds
- ⊙ Noise filtering from raw data
- ⊙ Background level (ground) extraction when idle
- ⊙ Image registration for matching vehicle patterns
- ⊙ Motion & cabin detection from consecutive frames
- ⊙ Mesh triangulation for volume estimation
- ⊙ 3D surface reconstruction for visualization
- ⊙ 1 degree of freedom: Fixed cameras + moving vehicle

Pilot installation @ Mount Paiko



Pilot installation @ Mount Paiko



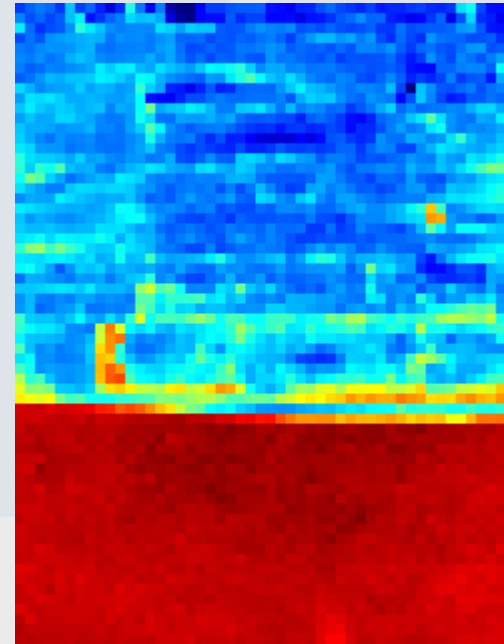
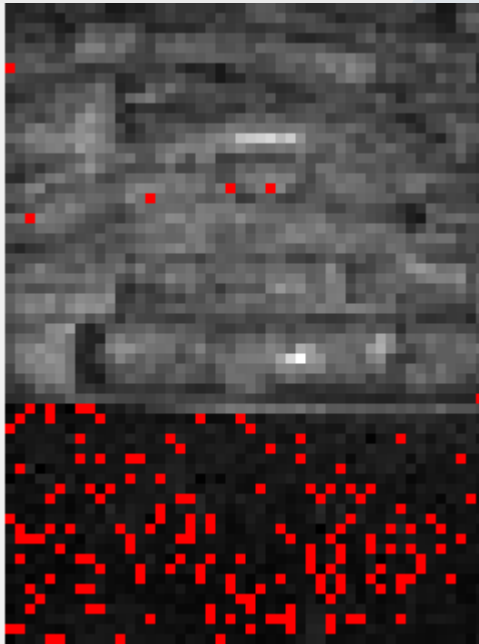
Pilot installation @ Mount Paiko



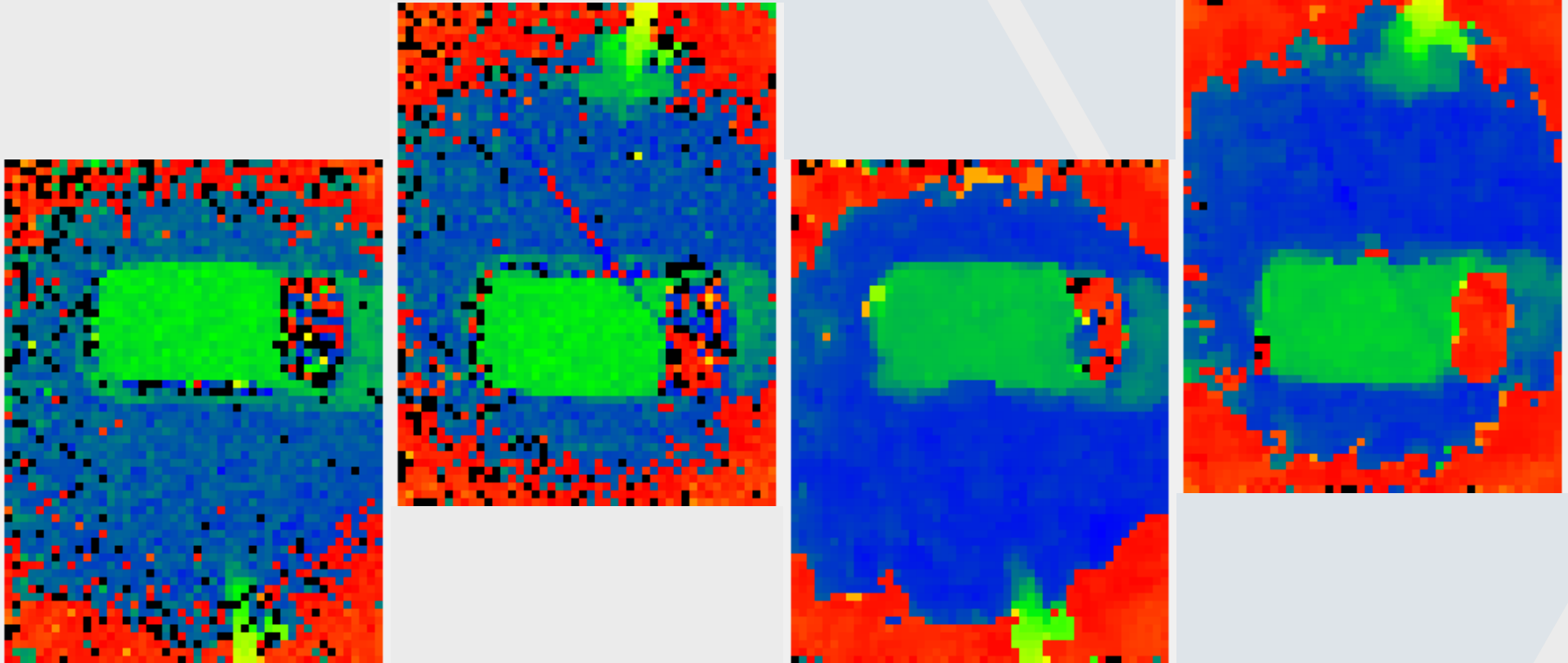
Pilot installation @ Mount Paiko



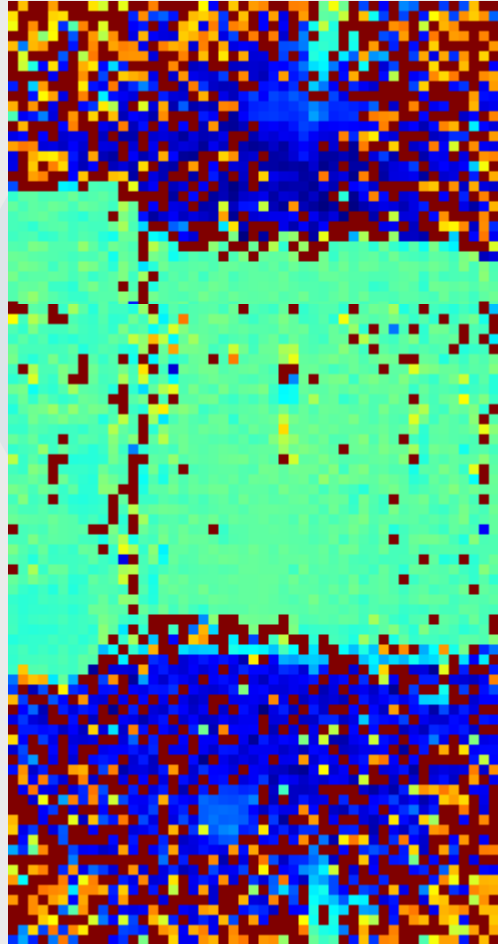
3D sensor timber samples



3D raw data examples (de-noising)



Combined raw data (truck cabin)



3D imaging data & volume estimation

