Competence Centre on Simulation and Big Data

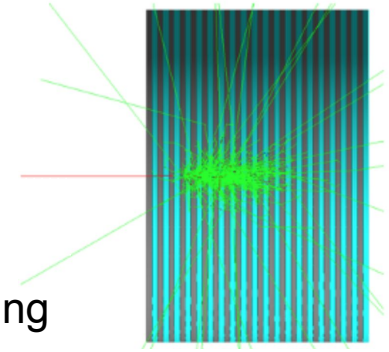
LIP Advisory Committee Meeting

Lisbon, April 28 2026

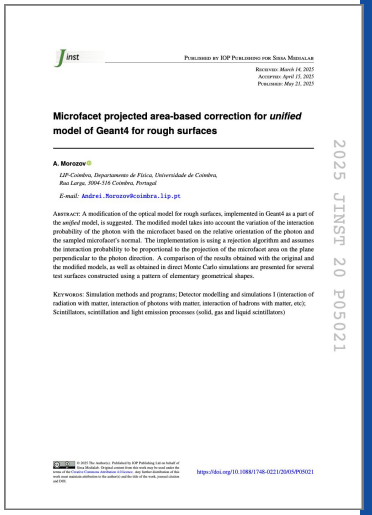
LIP

Competence Centre on Simulation and Big Data

Highlights - simulation



- Teaching of advanced detector simulation techniques at various levels;
- Use of the **Virtual Radiation Laboratory** in academic courses, providing flexible hands-on learning in radiation detection and detector performance;
- Participation in the Geant4 collaboration :
  - Maintenance of a Geant4 Advanced Example (optical simulations)
  - Improved modelling of optical surface roughness (ORimag LIP group) :
  - Assess feasibility of integrating the proposed modifications into the Geant4 toolkit.



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Microfacet projected area-based correction for *unified* model of Geant4 for rough surfaces

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ABSTRACT: A modification of the optical model for rough surfaces, implemented in Geant4 as a part of the *unified* model, is suggested. The modified model takes into account the variation of the interaction probability of the photon with the microfacet based on the relative orientation of the photon and the sampled microfacet's normal. The implementation is using a rejection algorithm and assumes the interaction probability to be proportional to the projection of the microfacet area on the plane perpendicular to the photon direction. A comparison of the results obtained with the original and the modified models, as well as obtained in direct Monte Carlo simulations are presented for several test surfaces constructed using a pattern of elementary geometrical shapes.

KEYWORDS: Simulation methods and programs; Detector modelling and simulations I (interaction of radiation with matter, interaction of photons with matter, interaction of hadrons with matter, etc); Scintillators, scintillation and light emission processes (solid, gas and liquid scintillators)

https://doi.org/10.1088/1748-0221/20/05/P05021

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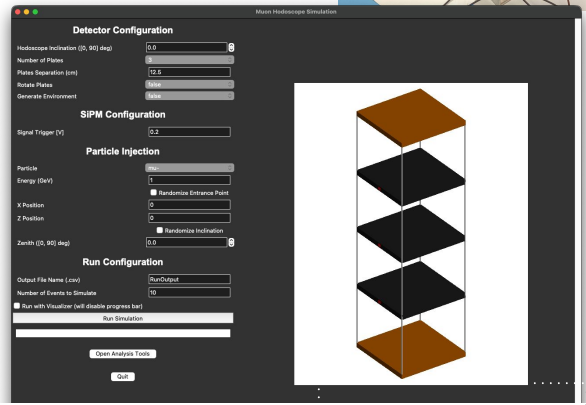
Highlights - simulation

VRLab updates and other developments

- Added production and transport of scintillation light; introduced structured, external materials configuration;

- **Muon hodoscope** simulation :
  - Improved GUI and analysis tools
  - Realistic atmospheric particle flux;
  - Good agreement with measured data.

- Major **VRLab upgrade** underway :
  - GUI : Python → Qt6
  - Containerization : ease of distribution, installation, ...



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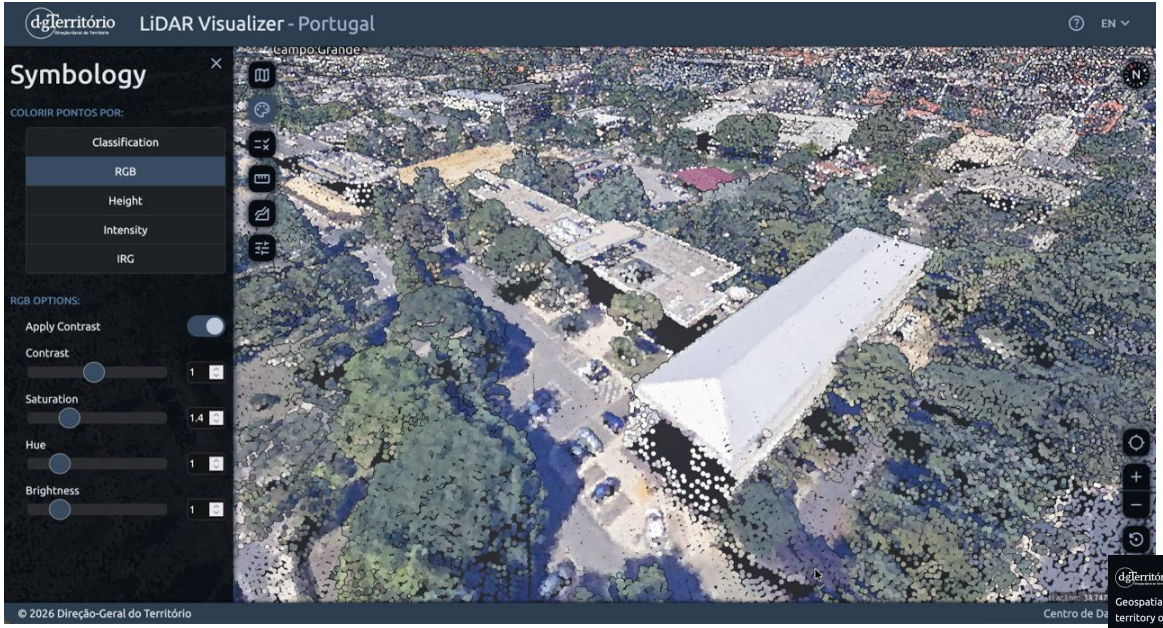
Highlights - DGT / LIDAR (Light Detection and Ranging)



Development of **fluid** visualizer from LIDAR data

https://portugal3d.dgterritorio.gov.pt/

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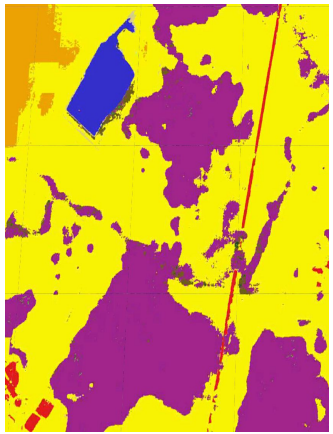
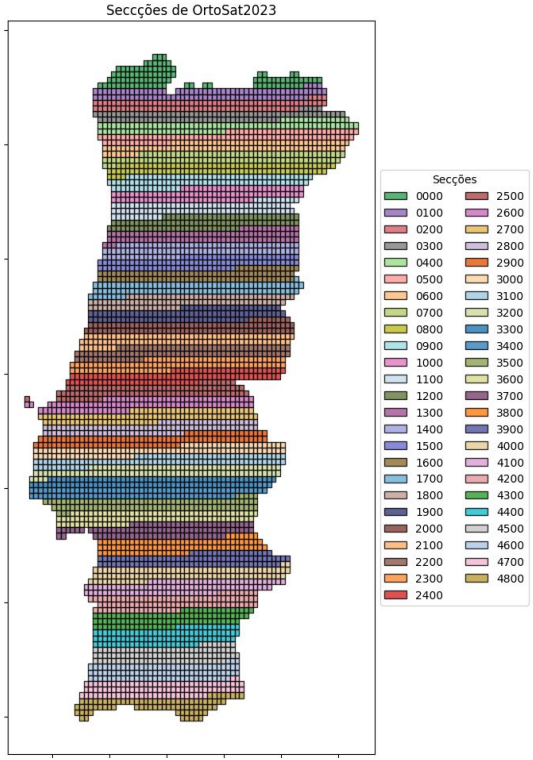
Highlights - DGT / Land Use Map from Very High Resolution Images





- Using dataset of 30 cm resolution images of continental Portugal taken by Airbus Pléiades Neo (from 2023).
- Image segmentation and classification problem addressed with deep learning with weak supervision (no labels for training).

Competence Centre on Simulation and Big Data
SWOT

Strengths

Integration in international collaborations (HEP experiments, Geant4 collaboration)
Diverse team, consolidated by competitive fundings (some secured by the Competence Center)
Good synergies with the computing team and National Centre for Advanced Computing (CNCA)

Weaknesses

Limited access to computing resources
We continue to improve the communication between groups, but there is still work to be done
Difficulties to attract and retain talent in areas with large demand for trained people

Opportunities

The projects with DGT demonstrated capability for knowledge transfer outside academia
Cooperation with CNCA

Threats

External services in simulation and big data are highly competitive outside some niche areas