Lidar Applications in Forest Inventory and Related Statistical Issues

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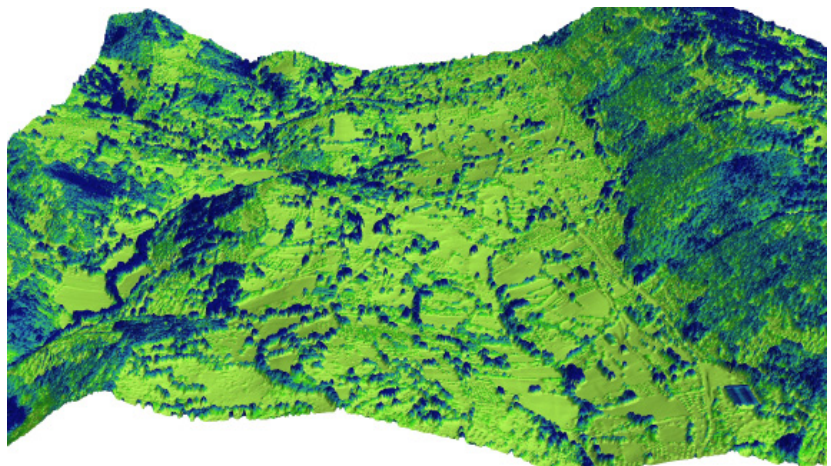
The increasing availability of space-borne or air-borne lidar data offers the potential to exploit this three-dimensional information alone or in combination with remotely sensed multispectral images to support forest inventories for the estimation of forest attributes at various scales.

The availability of air-borne lidar data can range from a full coverage over a given territory, where these data can be exploited as ancillary data known for the entire population, to a sample of the territory based on transects below the flight lines to spot samples within transects in order to adopt multiphase/ multistage estimation approaches, for example. However, the potential to integrate air-borne lidar information in forest inventories at various scales under a sound statistical framework is an aspect to be further developed.

The research workshop on "Lidar Applications in Forest Inventory and Related Statistical Issues" held on 8 May 2013 and hosted by the University of Tuscia, Viterbo, Italy, was conceived to allow participants to exchange information and experiences about such issues. It was attended by 70 researchers from Italy, USA and Sweden and involved IUFRO Units 4.02.04 and 4.02.06. The workshop was sponsored by the Accademia Italiana di Scienze Forestali, Associazione Italiana di Telerilevamento, Consiglio per la ricerca e la sperimentazione in agricoltura, Forestry Research Centre, Società Italiana di Selvicoltura ed Ecologia Forestale.

The results presented and the discussions carried out during the meeting suggest that air-borne lidar-based information widely proves to be well correlated to forest attributes and can be used to support the estimation of various quantitative variables, such as biomass or growing stock volume, and for discriminating forest in different classes on the basis of structure and forest management (e.g. coppice *vs* high stands).

Various analysis and estimation techniques can be used along with the support of air-borne lidar data, obtaining good results in various conditions, from Alpine to Mediterranean environments. The benefit of using optical multispectral imagery in conjunction with air-borne lidar data appear relatively limited. The maximum allowed scanning angle should be limited to 10° since several metrics derived from lidar data are sensible to these characteristics.

Air-borne lidar-based information can be considered from the beginning of a forest inventory supporting the set-up of multistage/multiphase sampling designs (i.e. lidar data acquisition is conceived as a part of the sampling design) or just after the end of the field survey, prevalently to support small area estimations, wall-to-wall mapping or the treatment of missing field data.

The exploitation of air-borne lidar-based information for monitoring/inventorying forest (volume/biomass) changes is devised as a distinctively challenging current topic for forest inventory research. Specific attention is to be paid to the fact that local forest conditions and characteristics of the air-borne lidar acquisition may alter the relationship between forest variables and lidar-based metrics over time. Therefore, forest inventory and remote sensing specialists should cooperate even more closely.

Related websites: www.aisf.it; www.aitonline.org/; www.dibaf.unitus.it; www.sisef.org; www.selvicoltura.eu Powerpoint presentations at: http://forestlab.net/ download/lidar-workshop-university-of-tuscia/

Illustration: Canopy Height Model in 3D visualization, colors range from green to blue from lower to higher heights. Picture provided by Gherardo Chirici.