Management and analysis of high resolution multibeam sonar surveys for geometry characterization of riverbed material

Simone Rover[1], Gabriele Avancini[2] and Alfonso Vitti[1]

[1] Dept. of Civil, Environmental and Mechanical Engineering, University of Trento, Italy - [2] ETS S.r.l., Latina, Italy

Objective

Combining high resolution river bathymetry, acquired by means of an unmanned surface vehicle (USV) equipped with a multibeam echosounder (MBES), with an advanced processing analysis in order to define an operating procedure allowing the geometric characterization of riverbed material.

Introduction

river basins management

geometric characterization of riverbed material

morphodynamics

river ecomorphology

hydraulic models

Even if there are many techniques that make it possible to obtain bathymetry, geometric information, such as surface grading curve or roughness indexes, are not easily achievable due to the need for digital surface models at high spatial resolution.

- Field sampling methods
  - \+ accurate
  - – time consuming
  - – small spatial coverage
  - – reduced number of samples
  - – limited by hydraulic condition
- Satellite or aircraft imagery, airborne lidar and through-water photogrammetry
  - \+ large spatial coverage
  - – limited by water turbidity
  - – poor resolution
- **Echo sounder**
  - \+ high resolution
  - \+ compact dimension
  - \+ light weight

  } Ideal as payload for **USV**

Devices

- Unmanned surface vehicle
  - cheaper than traditional research vessel
  - easily transportable
  - suitable for shallow water navigation

Figure 1: USV and relative antenna for remote control

- Multibeam echo sounder
  - high spatial resolution
  - elevate sampling rate
  - wide coverage compared to single beam technology

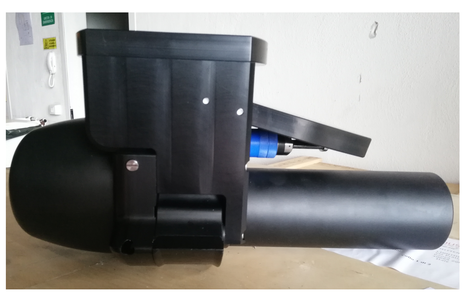


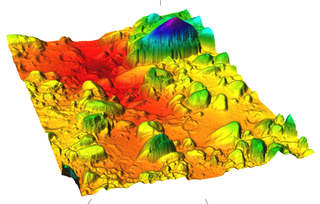
Figure 2: Cylindrical MBES used

Methods

field survey

point clouds

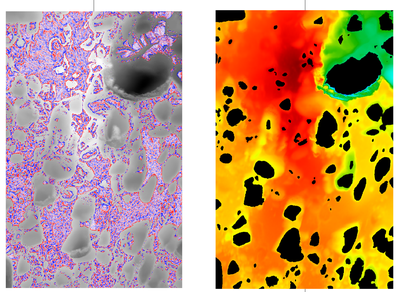
DSM



flat areas

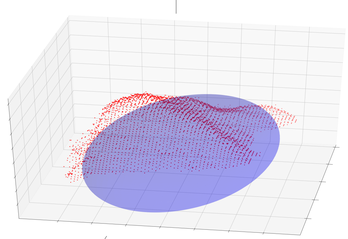
rugosity

stones



points extraction

ellipsoid fitting



useful geometric informations

Conclusion

Challenging aspects

Very accurate and precise positioning system, required both for navigation but especially for co-registration of point clouds, and careful calibration of sensors.

We adopt an original technique to extract forms from high resolution point clouds and, using numerical simulation, investigate the link between geometric parameters and the sediment grading curve of the surface layer of rivers.

Even considering some sources of uncertainty that may be present from field survey to modelling, with a confidence range derived by statistical analysis, it is possible to identify and geometrically characterize the most of the forms present on the riverbed.

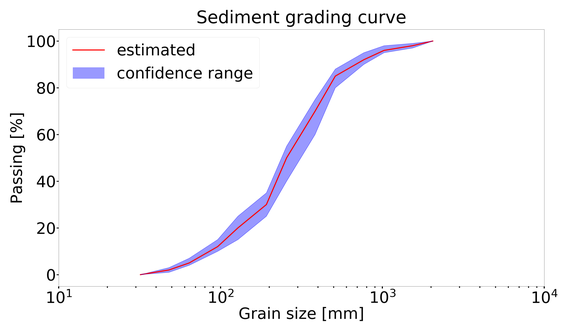


Figure 3: Example of sediment information achievable

Contact Information

- Email: simone.rover@unitn.it
  gabriele.avancini@etsingegneria.it
  alfonso.vitti@unitn.it