Collection and Interpretation of Point Clouds of Terrestrial Laserscanning as a Basis for Hydraulic Flow Modelling
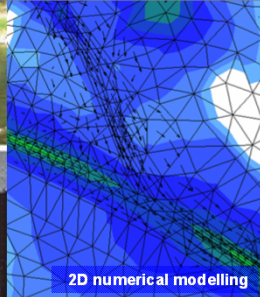
Karl Zippelt and Rebekka Czerny

Geodetic Institute, Institute of Water and River Basin Management

Terrestrial Laser Scanning · Photo · TLS point cloud · 2D numerical modelling

KIT – The cooperation of Forschungszentrum Karlsruhe GmbH and Universität Karlsruhe (TH)

Background

- **Aim**
  Development of a hydrodynamic numerical model of a restored river reach

- **Such restored river reaches often show…**
  - a complex geometry of the riverbed
    (shallow /deep water zones, sills, flow obstacles,...)
  - structures on the bank / in the foreland

  → complex hydraulic situation

  - high diversity of vegetation

The creation of a hydraulic model of a nature-oriented reach requires a <u>detailed field survey.</u>

Example of a restored river section in the city of Lörrach (January 2008)

Acquisition of detailed geodata

- **Terrestrial Laser Scanning**

  - Advantages
    - highly detailed, exact survey of the ground, structures, vegetation
    - high speed of data-collection

  - Disadvantages
    - extensive efforts for data processing (rectification, thinning out, filtering)
    - no measuring of zones under water
      → survey during low water
      → combination with data collected by means of other survey methods

  Research cooperation:
  Geodetic Institute (GIK)
  Institute for Water an River Basin Management (IWG)

Geometry Processing (Workflow)

Data recording

Registration

Pre-Processing / Cleaning

Segmentation

Vegetation Filtering

DTM

Hydraulic Model

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Area of Investigation

Drainage area

Longitudinal section

Area of Investigation

200 x 50 m
Low waterlevel

© de.wikipedia.org/wiki/Wiese_(Fluss)

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Laserscanning as a Basis for Hydraulic Flow Modelling

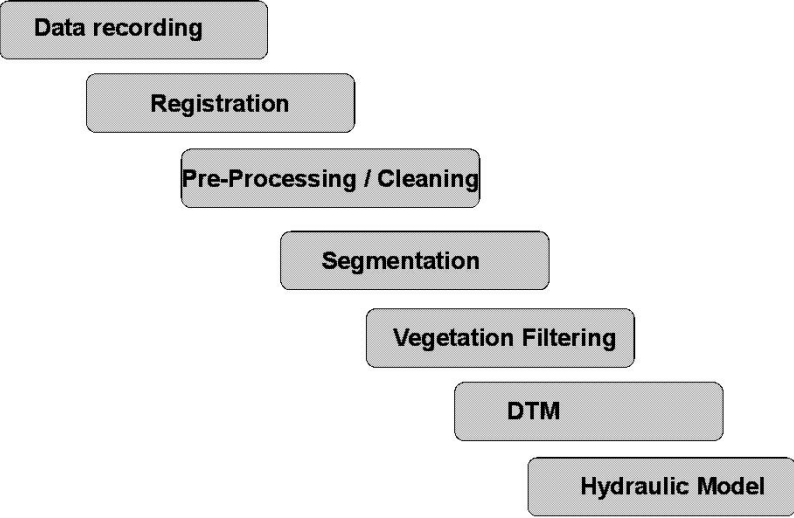Forschungszentrum Karlsruhe
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Universität Karlsruhe (TH)
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Details of the Riverchannel (Wiese/Lörrach)

Bildquelle: Boettcher, RP Freiburg

Hydraulic structures

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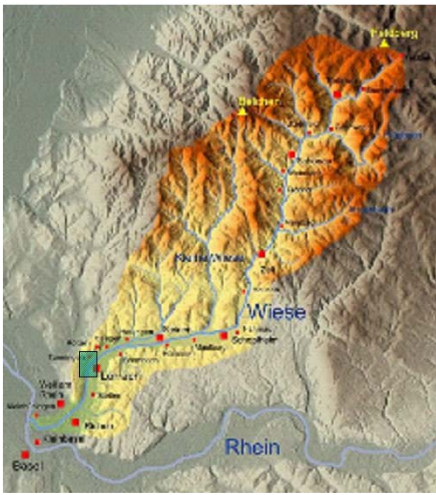Laserscanning as a Basis for Hydraulic Flow Modelling
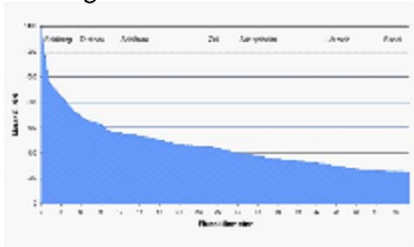
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Pointcloud in the range of water

Pointcloud of the riverchannel characterized in
- Nearby the station:
  In shallow water the topography of riverchannel seemed to be captured

- Waterdepth > 20 cm
  small angle to watersurface   } no reflected laserbeam

- Objects far from station give uncertain reflections

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Laserbeam in/through water
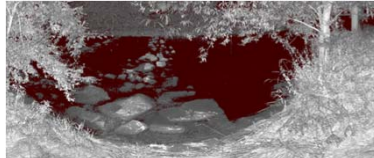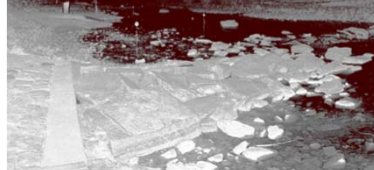
Intensity of captured Laserbeam around a stone sill and shallow water

High intensity of stones

Low intensity of shallow water

No intensity in deep water

stones

shallow water   cross-section in pointcloud

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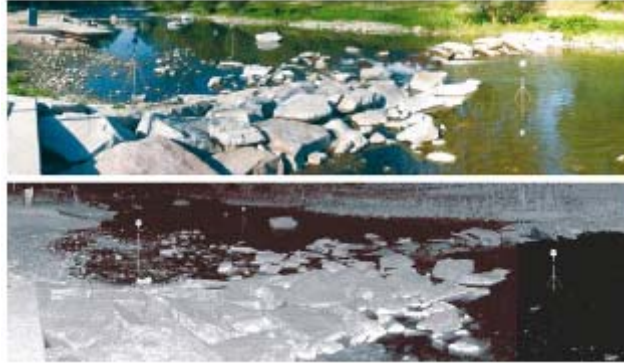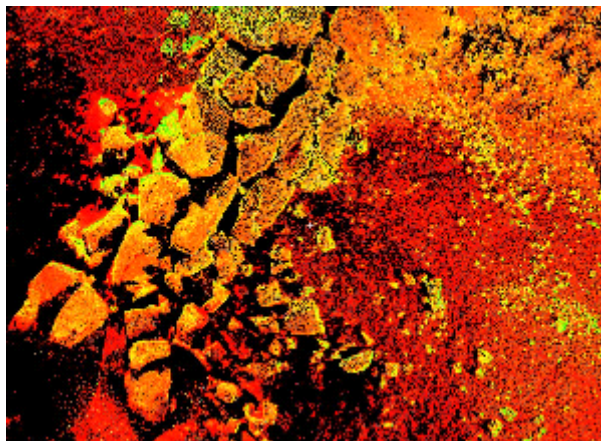Forschungszentrum Karlsruhe in der Helmholtz-Gemeinschaft   Universität Karlsruhe (TH) Research University · founded 1825
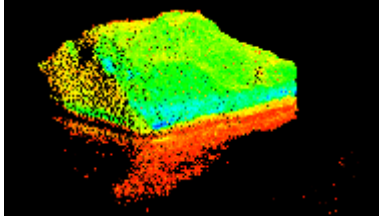
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Optical Reflexion by Watersurface
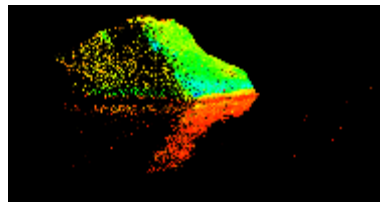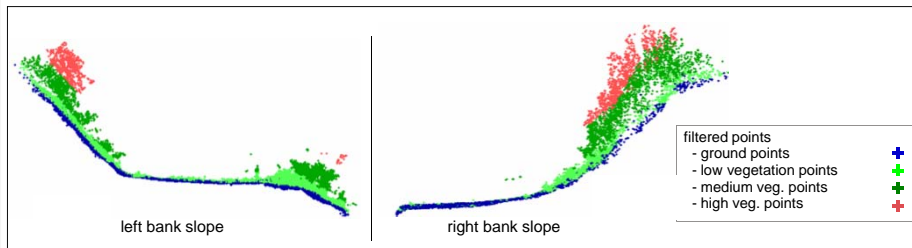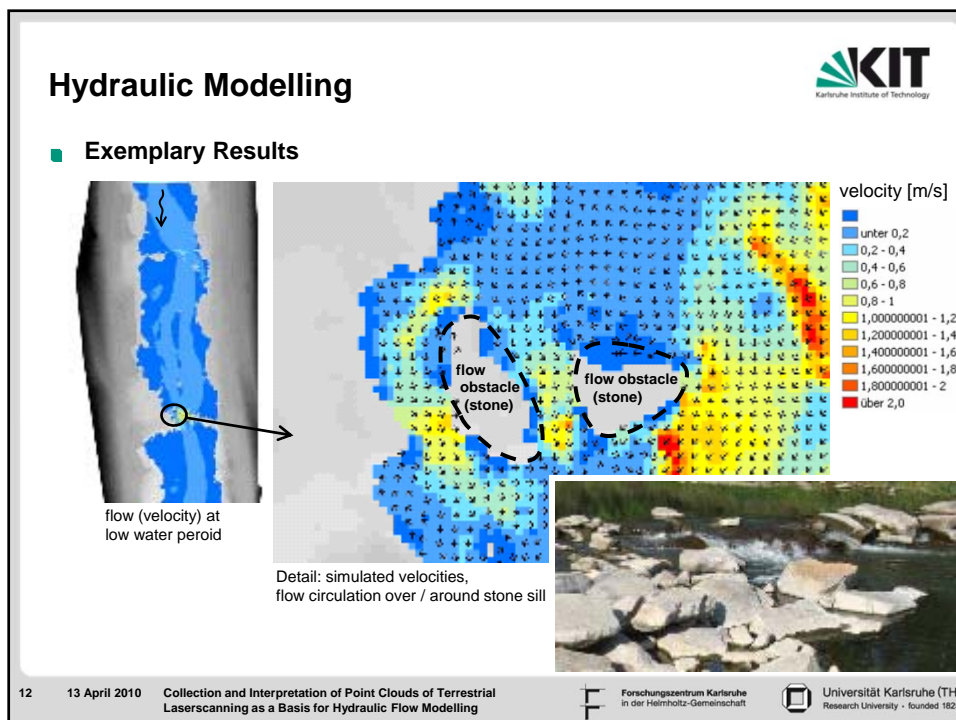

Objects located in the water channel

Partly above/under water

High reflections of visible parts

Low reflections of overflowed parts

Interpretation: Mirror of visible parts after optical reflexion of the laserbeam

no correction is possible

Processing of pointcloud

- **Vegetation filtering**
  - Method:
    Hierarchic robust filtering (Software SCOP++[*]), generally used for filtering of ALS data
  - Modification of the weight function and the filtering parameters due to the smaller scale when handling TLS data
  - works well in areas with vegetation

left bank slope

right bank slope

filtered points
- ground points
- low vegetation points
- medium veg. points
- high veg. points

(*) Inpho Gmbh, Institute for Photogrammetry and Remote Sensing of the TU Wien (2007)

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Processing of pointcloud

Modelling

Combination of different types of geodata

TLS point cloud
Tachymeter points

Hierarchic robust filtering

unfilterted original data

filterted / thinned out original data

TIN

Grid / DTM

computational mesh

Triangulation / interpolation

Rasterisation

mesh generation

Basis for hydraulic modelling

Hydraulic Modelling

Exemplary Results

velocity [m/s]
unter 0,2
0,2 - 0,4
0,4 - 0,6
0,6 - 0,8
0,8 - 1
1,000000001 - 1,2
1,200000001 - 1,4
1,400000001 - 1,6
1,600000001 - 1,8
1,800000001 - 2
über 2,0

flow obstacle (stone)

flow obstacle (stone)

flow (velocity) at low water peroid

Detail: simulated velocities, flow circulation over / around stone sill
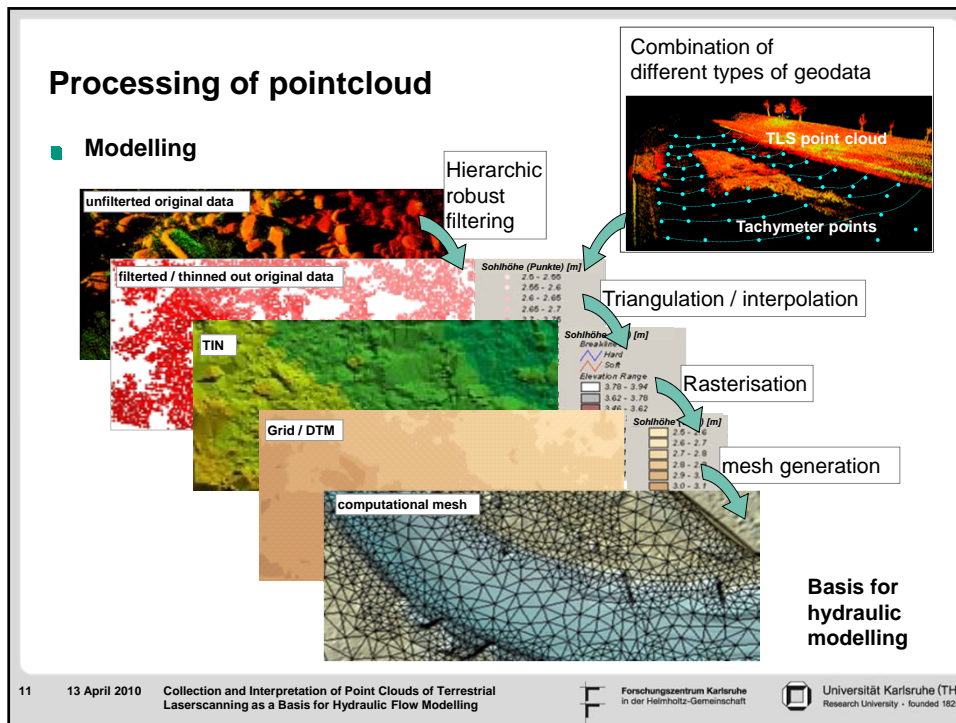
Thank you for your attention!