Advanced use of LiDAR data - Automatic building vectorization and contour production
FIG 14.4.2010
Terrasolid Ltd.

- Founded in 1989 – 20 years history
- Infrastructure software development and sales
- Revenues in 2009 ~ 3.5 M€
- Customers in 90+ countries
- Global market leader in airborne and mobile laser scanned point cloud processing software
- Market share around 85%
- Based in Finland

Airborne LiDAR

- Laser scanner and digital camera mounted into an aeroplane or a helicopter
- Up to 300,000+ points per second
- Scanner mirror rotates to create a scanning pattern
- Digital photographs every 1 to 3 seconds
- Precise location and position tracking with GPS and IMU (Inertial movement unit)
Automatic Building Vectorization

• For airborne laser data + images
• The goal is to produce approximate 3D vector models automatically
• Relies on the point cloud classification to
  – Ground
  – Height from ground
  – Buildings
• Manual editing tools provided

Buildings & Point Density

• Higher point density → more accurate models
• Low density < 2 points / m²
  – Good models of large buildings
  – More problems with small buildings
  – Loss of detail structures
• Medium density 2-10 points / m²
  – Good models
• High density > 10 points / m²
  – Accurate models
  – Can do details
Turku Area

- Close to 2000 km² of Finnish National Land Survey data
- 3 billion points -- 1.5 points / m² after cut overlap
- Matching of flightlines done
- Automatic ground done – no manual editing
- Automatic building classification do – no manual editing
- Automatic vectorization done – no manual editing
- Vectorization took 6 hours on notebook & USB drive
FIG Congress 2010
Facing the Challenges – Building the Capacity
Sydney, Australia, 11-16 April 2010
DTMs and Contours

Purpose of a digital terrain model is to:
- Pass information about terrain elevations to a computer
- Make it possible to compute quantities, draw profiles, classify laser points, visualize the terrain on screen...

Purpose of contours is to:
- Be plotted on paper
- Pass information about terrain elevations to a human

Contours

- A highly accurate model produces ugly contours
- Contours can not be accurate and pretty at the same time
- You have to balance between accuracy and prettiness when producing contours
- Bad model makes good contours!
Contours & Laser Data

Ground model from laser data is:
- Very accurate
- High density
- Is noisy – points have elevation variation

Laser data is difficult for producing contours
- Difficult to accept how bad you have to make the model to produce good contours

Contour keypoints
- Classification which selects points to be a ground model for contour production
- Similar to model keypoints but tailored for contours
- For smooth, nice looking contours
- User controls how big volumetric difference to true ground is allowed
# How Bad Is It?

<table>
<thead>
<tr>
<th></th>
<th>Points</th>
<th>Avg dz</th>
</tr>
</thead>
<tbody>
<tr>
<td>All ground points</td>
<td>836 069</td>
<td></td>
</tr>
<tr>
<td>Model keypoints 10 cm</td>
<td>162 329</td>
<td>2.6 cm</td>
</tr>
<tr>
<td>Model keypoints 20 cm</td>
<td>66 270</td>
<td>5 cm</td>
</tr>
<tr>
<td>Smooth 10 cm, key 40 cm</td>
<td>18 339</td>
<td>10 cm</td>
</tr>
<tr>
<td>Contour key 1</td>
<td>813 782</td>
<td>0.1 cm</td>
</tr>
<tr>
<td>Contour key 13</td>
<td>160 737</td>
<td>3.0 cm</td>
</tr>
<tr>
<td>Contour key 23</td>
<td>64 395</td>
<td>6 cm</td>
</tr>
<tr>
<td>Contour key 50</td>
<td>14 772</td>
<td>11 cm</td>
</tr>
<tr>
<td>Contour key 100</td>
<td>3 961</td>
<td>16 cm</td>
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</tbody>
</table>