TRAINING CANADIAN OLYMPIC SKIERS WITH STEALTH™

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CRC/iCORE CHAIR IN WIRELESS LOCATION
PLAN GROUP
GEOMATICS ENGINEERING

ION ALBERTA SECTION, 12Feb10
Introduction

• Competitive alpine skiers win or lose races by fractions of a second
• Precise position and timing information during training is critical
Challenges

• Accuracy of 10 cm and 1 ms, 20 times per second
• Negligible influence on skiers up to 130 km h\(^{-1}\)
• Robust and easy to use device less than 500 g, power autonomy of 4 hours, -20° C
• Suitable data presentation & interpretation for skiers and coaches
• Training for downhill, super-giant slalom, giant slalom, and ski testing
Can GPS Do It?

- Yes in principle, but
- Topography limits signal visibility
- Weight and power are constraining
Program Launch

• Top-Secret program launched by Canada’s Own
  The Podium/A Nous le Podium 2010 in
  collaboration with PLAN Group, Schulich School of
  Engineering, University of Calgary in 2006…

• …To develop a GPS-based device that would meet
  pre-defined requirements

• Result, three years later:
  Sensor for the Training of
  Elite Athletes (STEALTH™)
Early Testing (Oct 06)

- To test viability of approach
- Use of standard equipment
- GPS performance exceeded accuracy requirement with topographic blockage up to 30°
Field Prototype (Feb 07)

- Purpose: To produce an integrated prototype for tests with live skiers and coaches
- Development of hardware
- 370 g, 4-hour autonomy
- Testing on the slope
Testing at Panorama – Apr 07
Not All Ideas Work Out Well…
But very successful – Moved on to operational system development
Operational System – Aug07

• **Minimized size** and weight
  • 25 kg → 370 g → **280 g**
  • 37 x 77 x 131 mm

• **Ruggedized** platform
  • 3.2 mm thick delrin casing

• **Maximized** performance
  • NovAtel’s GPS+GLONASS card
  • Up to 8 hour continuous use

• **Added features**
  • External sensor synch.
STEALTH Embedded Architecture

- Secondary sensors
  - Hardware support
  - Not currently needed

- NovAtel OEMV1-G
  - GPS+GLONASS L1

- Power Control
  - 4.4 Ah lithium cell monitor
  - System fault protection

- System Processor

- User Input (Tactile)
  - Survey
  - Begin Run
  - Power

- Indicators (visual)
  - Power
  - Status
  - Time pulse

- FAT/FAT32 SD-Card.
  - Does not use a proprietary file system

125 mm

67 mm
Mounted Field Hardware
Training with STEALTH™
(Nakiska, 12Nov09)
AlpineGNSS Graphics™ (1/2)

• Interactive display software
• Skier trajectory parallel to hill face & height profile
• Parameters of interest:
  • Elapsed time, speed
  • Acceleration along and across track
  • Turn radius
• Interactive cursor displays speed & other parameters
## AlpineGNSS Graphics™ (2/2)

<table>
<thead>
<tr>
<th>Skier name</th>
<th>Skier #1</th>
<th>Skier #2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Run number</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Elapsed playback time (s)</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Elapsed time since start (s)</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Distance traveled (m)</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Speed along track (km/h)</td>
<td>41.02</td>
<td>46.07</td>
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<tr>
<td>Acceleration along track (m/s^2)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Acceleration across track (m/s^2)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Turn radius (m)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total run time (s)</td>
<td>10.697</td>
<td>10.321</td>
</tr>
<tr>
<td>Average speed (km/h)</td>
<td>67.23</td>
<td>69.36</td>
</tr>
</tbody>
</table>
Amateur Vs Elite.

Nakiska – 9Feb10: STEALTH + NovAtel FlexPakV2 L1L2G
Verifying Accuracy through Height Repeatability

Top of hill - height profile

Bottom of hill - height profile
Summary

• System used routinely by Canadian Team since 2007 for training purposes

• One of many technologies used by team to enhance performance

• Future: Further enhancements and other applications:
  - Relative trajectory
  - Probability of correct fix with GPS/GLONASS L1 and L1/L2
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• Own The Podium/À Nous le Podium 2010
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• iCORE
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