Harmonised eCall European Pilot

# SATELLITE POSITIONING FOR eCALL: AN ASSESSMENT OF GPS PERFORMANCE

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# Filjar et al:
# SATELLITE POSITIONING FOR eCALL

- Structure of presentation
- Introduction – the eCall
- Background
- GPS performance for eCall
- Field campaign
- Data analysis methodology
- Data analysis and discussion
- Conclusion and future work

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- Introduction – the eCall
- Telecom service aimed to provide:
  - Automatic notification of road traffic accident to a Public Safety Answering Point (PSAP)
  - Direct and automaticly established communication between PSAP operator and people in vehicle

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- <u>Introduction – the eCall</u>
- Harmonised eCall European Pilot (HeERO project) – pan-European CIP ICT pilot aimed to verify expected eCall performance throughout EU
- Croatian eCall Pilot led by National Protection and Rescue Directorate, Ericsson Nikola Tesla, and Croatian Automobile Club

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- <u>Background</u>
- GPS as the sole means for position determination for eCall (standardisation)
- Potential GPS vulnerabilities, misleading information and misconduct of personnel can lead to disastrous consequences
- HeERO to identify threats and provide advice for GPS vulnerabilities mitigation for eCall

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- GPS performance for eCall
- Case-specific requirements:
  - Avilability of positioning service
  - Position estimation accuracy



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- GPS performance for eCall
- Availablity of positioning service – depends on GPS system reliability and the effects of local terrain

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- GPS performance for eCall
- Position estimation accuracy depends on:
  - Geometric dillution of precision
  - User Equivalent Range Errors (ionospheric delay, multipath, satellite clock error, satellite emphemeris error etc.)

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- GPS performance for eCall
- Key Performance Indicators for eCall position estimation
  - Position estimation accuracy
  - Number of usable satellites
  - Geometric Dilution of Precision (GDOP)
  - Time between consecutive successful positioning fixes

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- GPS performance for eCall
- GPS vulnerabilities critical for eCall:
  - The age of position estimate
  - Loss of lock with satellites
  - Effects of local positioning environment



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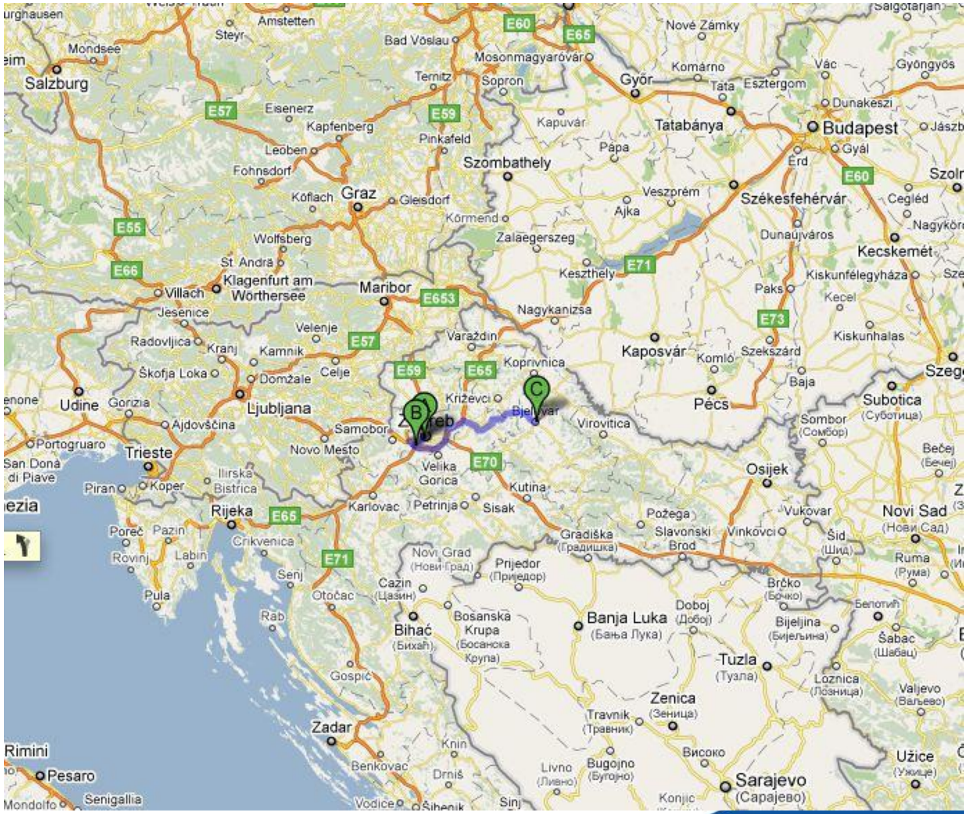
- <u>Field campaign</u>
- Zagreb – Bjelovar route
- Combination of motorway and regional road in sub-urban and rural (hills, forrests, flat landscape) environment

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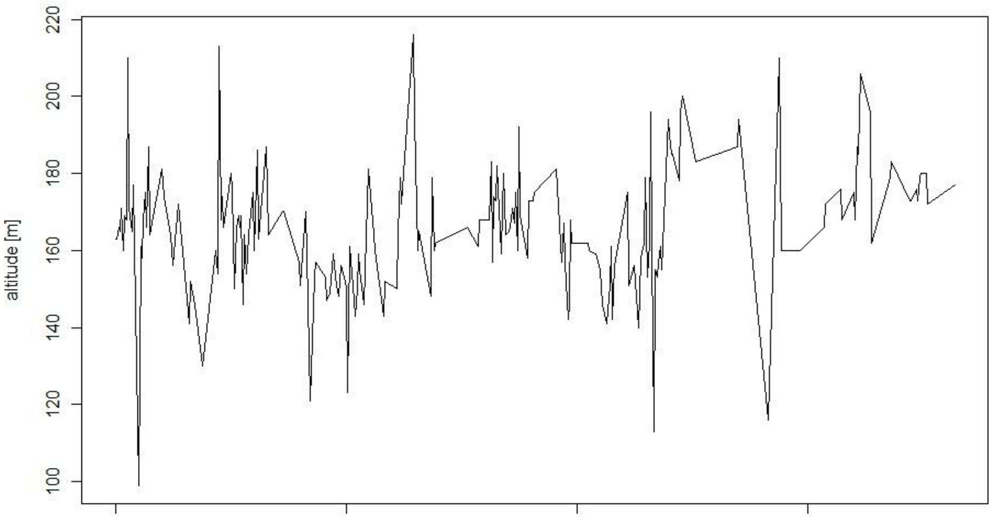


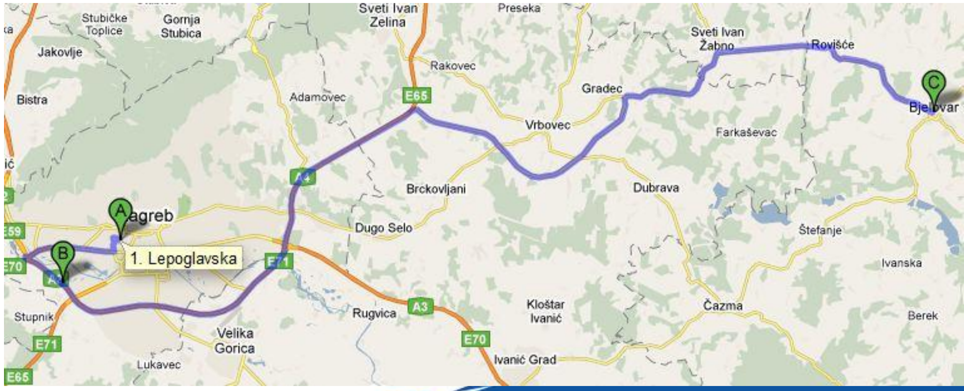

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- Data analysis methodology
- Analysis of time-series of time-stamps in which the GPS position estimates were taken (time between successful consequitive GPS fixes)

$$dt(t) = t_{sample}(t + 10\,s) - t_{sample}(t)$$

| hr | min | sec | latitude | longitude | altitude |
|---|---|---|---|---|---|
| 06 | 28 | 11 | 45.8041370 | 15.9464836 | 163.0 |
| 06 | 28 | 20 | 45.8039546 | 15.9470201 | 163.0 |
| 06 | 28 | 35 | 45.8034182 | 15.9480071 | 166.0 |
| 06 | 28 | 45 | 45.8037937 | 15.9472132 | 165.0 |
| 06 | 29 | 00 | 45.8035576 | 15.9476638 | 171.0 |
| 06 | 29 | 10 | 45.8037508 | 15.9472775 | 160.0 |

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- Data analysis and discussion
- Time between consecutive GPS samples: 33.4 s (mean), 13.0 s (median), 3.3 s (standard deviation)
- 126 out of 196 positioning samples taken within 20 s period from previous sample (64.3%)
- Position reporting uncertainty: up to 722 m

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- Data analysis and discussion
- 37 out of 196 samples (18.9%) taken within the time interval of  more than 50 s after the previous sample
- Position determination uncertainty of more than 6 km
- Hilly terrains around Zagreb and Bjelovar

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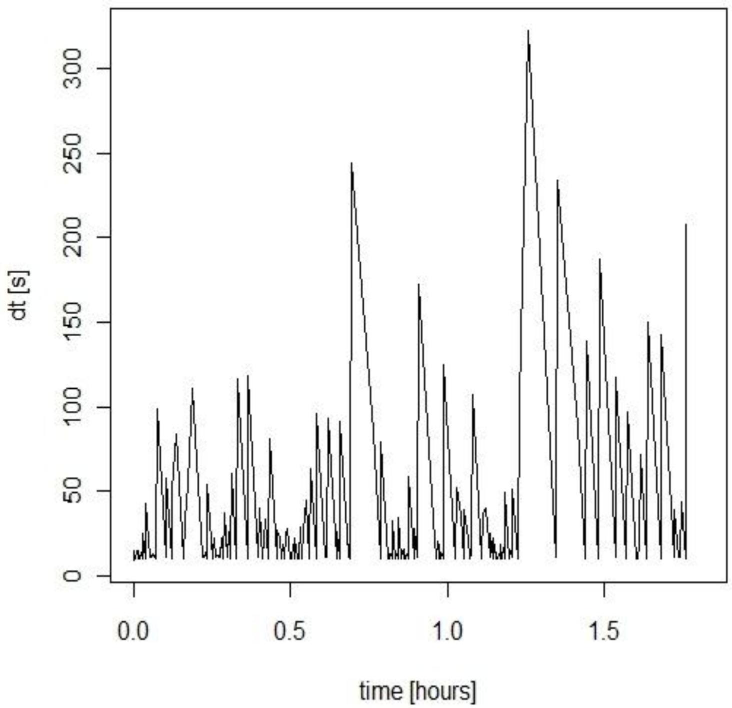
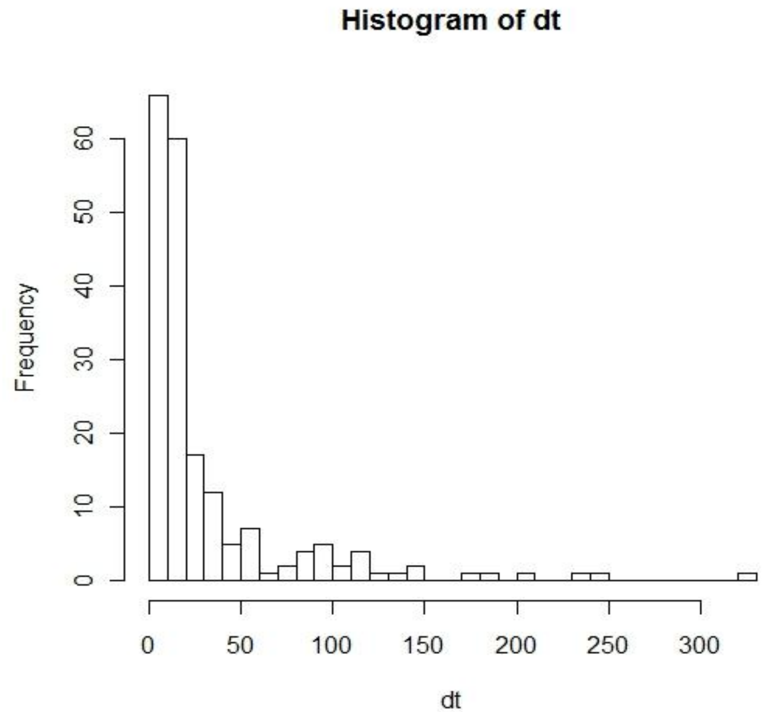
- <u>Data analysis and discussion</u>

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- Data analysis and discussion
- Position estimation process must not rely upon the single position estimation technology
- Other position estimation technologies needed -> position sensor integration
- Assistance, augmentation and combined GNSS receivers (GPS/GLONASS) recommended

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- <u>Conclusion</u>
- A single position estimation method only not acceptable for eCall
- Position sensor integration, augmentation, assistance should be utilised and standardised
- GPS vulnerabilities to be mitigated

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- Conclusion
- HeERO to validate GPS vs GPS/GLONASS vs GPS+EGNOS and the other combined position estimation methods for eCall
- Test drives in Zagreb, on Zagreb – Bjelovar road, and on Rijeka – Zagreb motorway to identify weak spots of GPS performance

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# THANK YOU FOR YOUR ATTENTION !

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