GPS/INS Vehicle Event Data Recorder

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Abstract: **The combination of the inertial micromechanical sensors, GPS receivers, MMC/SD card and suitable PC interface allows construction of event data recorders (EDR) for vehicles and cargo. The motion data are written continuously and experts could reproduce the road situation by a virtual reality at the road accidents. The proposed system is capable to update the navigation data (1Hz) and inertial data (up to 2560Hz).**

Keywords: **GPS, micromechanical sensors, event data recorder (EDR)**

I. INTRODUCTION

EDRs were originally intended to record what caused air bags to open. The data that triggers the air bag often tells the story of what happened in the seconds before crash. Using this data, insurance agents and police officers could reconstruct the events leading up to the crash. The EDR senses various conditions in and around the vehicle and the data could be analyzed subsequently.

EDRs record the following data [1]: vehicle speed, engine speed, brake status, throttle position, state of driver's seat belt switch, passenger's airbag, IR warning lamp status, time from vehicle impact to airbag deployment, ignition cycle count at event time, ignition cycle count at investigation, maximum velocity for near-deployment event, velocity vs. time for frontal airbag deployment event, time from vehicle impact to time of maximum velocity, time EDR related technologies include retrieving, gathering, and storing objective data which may improve highway efficiency, mobility, productivity and environmental quality by providing compelling evidence of the types of crashes, the role of human error, systems engineering and systems integration issues between near-deploy and deploy event.

One of the main systems of EDR is the inertial system (INS). The Micro-Electro-Mechanical Sensors (MEMS) accelerometers and gyroscopes are both sensors which can perfectly address to active safety systems in the automotive domain. MEMS sensors allows instantaneous detection of any information used by those functions, with a high level of precision and accuracy, with a very low impact in term of space, together with high level of integration with other systems.

Integrated an INS with a Global Positioning System (GPS) in one device the accuracy and the reliability increase. Kalman filtering is the basis for correcting the INS with GPS measurements of satellite range and range-rate [2]. At the same time, the INS provides smooth and accurate short-term measurements of acceleration and velocity that can be used to aid GPS receiver code and carrier tracking.

The proposed system measures some of parameters witch EDR really picks, this are the acceleration of three axes, angular rate and data from GPS receiver - velocity over the ground, course over the ground and geographic coordinates in ECEF system.

II. EDR TEST

The system architecture, the accelerometer design and the proposed operational algorithm is described in out previous work [3]. In order to demonstrate the values of signals from device were made some tests. The device was mounted approximately on the middle a bottom a car. The collecting data from each test are processed in Matlab with suitable program. The directions of the MEMS sensors axis are shown at Figure 1.

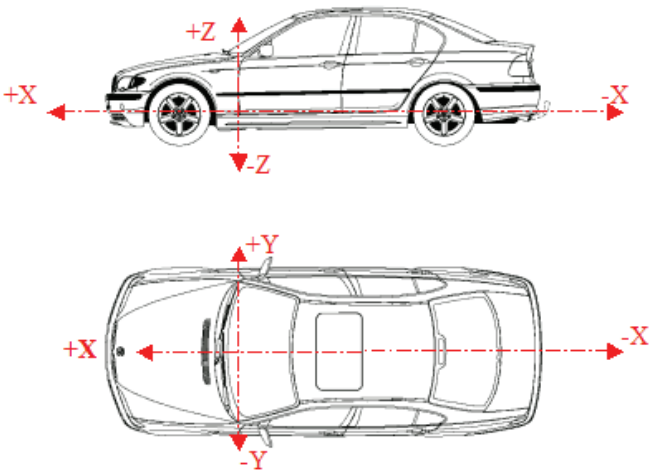

Fig.1. Inertial axis orientation

The EDR system test results are shown at Fig.2 as follows:

(a) test track view
(b) course graphics in degrees (according to NMEA)
(c) test speed curve in km/h
(d) System temperature in degrees Celsius
(e) X acceleration values vs G force

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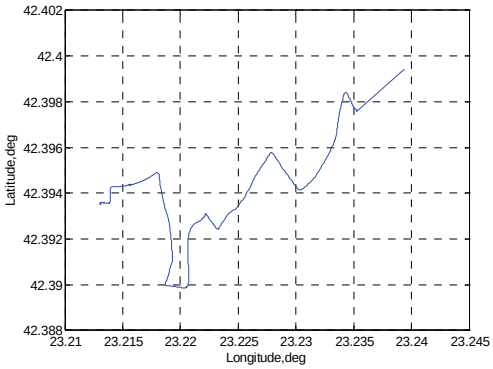
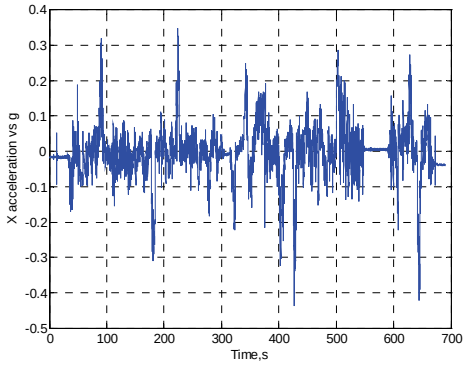


(a)



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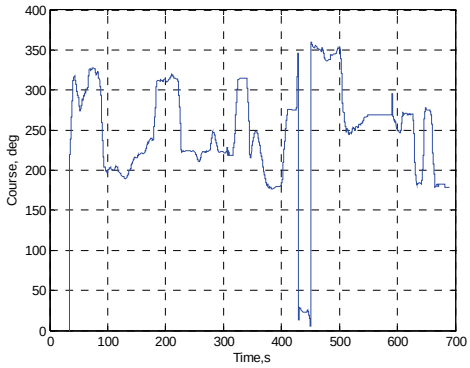

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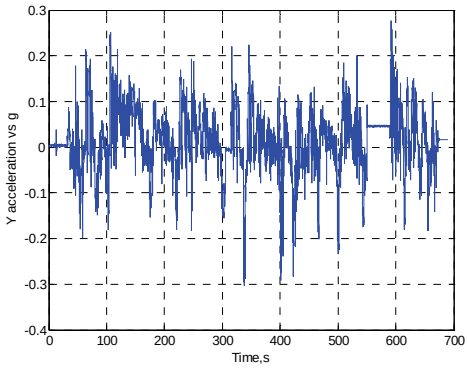

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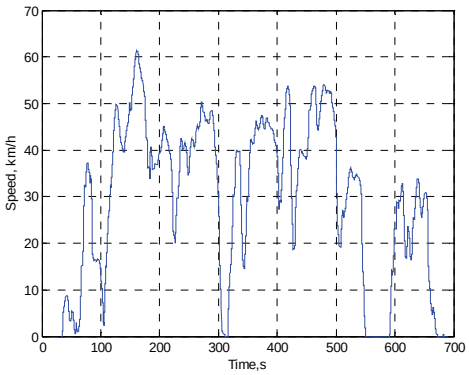
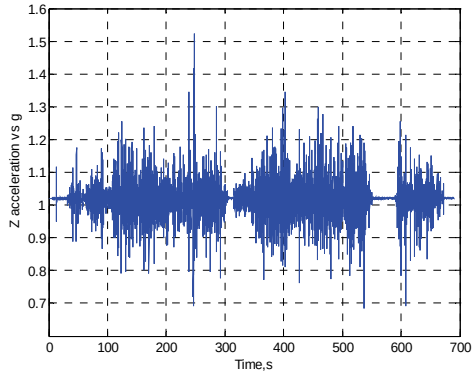
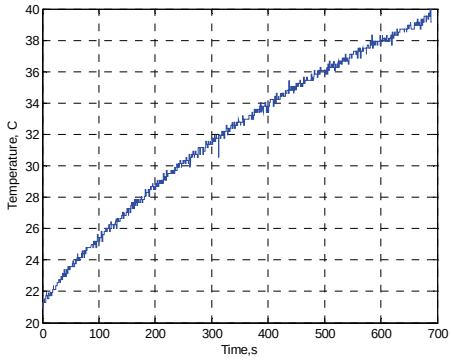


(c)



(g)



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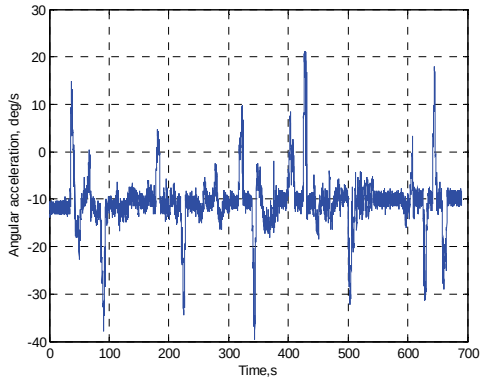

(h)

Fig.2. Test road results

(f) Y acceleration values vs G force
(g) Z acceleration values vs G force
(h) Angular acceleration values in deg/s

The obtained EDR results are processing to calculate the critical points, where the preliminarily defined values are exceeded. These boundary values are defined as follows:

- $|X_{max}|/g = 0,30$
- $|Y_{max}|/g = 0,30$
- $|Z_{max}|/g = 0,35$
- $|G_{max}| = 30deg/s$

The processed critical points are shown at Fig.3.

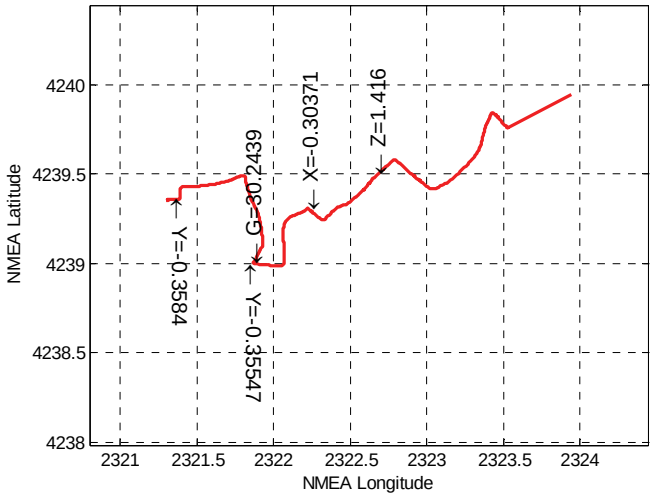

Fig.3. Processed critical points

The shown markers determined the position of the critical points and the critical values. It is clearly visible that the EDR system detects all dangerous curves driving (Y or Angular acceleration over limit values), the critical stops (X acceleration over limit) or vertical accelerations (Z axis value). In these points the speed and the vector movement may be obtained from the processed data and the complete object moving picture may be build.

III. Conclusion

The used GPS receivers allow specifying the object location with very high precision, which is completely sufficient to solve the complex transportation tasks. In the presence of the optional inertial module the system solves the complex analysis of the moving object state – brake system status, vibrations, risky driving, etc. Therefore, the system may be used as a base for automatic obtaining of the actual information, formation of the statistic database, which described the transport traffic, optimal transportation routes calculation and optimal traffic management.

References

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