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Simulation of the Motor Power of Line-of-Sight Stabilized Devices by Passing the Test Bump

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Abstract: The Gun (Elevation) Stabilization Bump Course (GSBC) of the Aberdeen Proving Ground (APG) is a special road test track which is used for quality testing of the line-of-sight (LOS) stabilized devices which are mounted into military vehicles. There are optical devices, antennas and guns which are components of the fire control systems for example. The methodology for the quality testing of the LOS stabilized devices using the design of the GSBC is the basic standard for appropriate devices testing in all NATO countries. We present a simulation model of the vehicle passing the GSBC in our contribution. The Matlab model generates vibrations of suspended parts of the vehicle. These vibrations can be used as the inputs in simulators of the suspended parts movement or as the input in simulation models of the servos of the LOS stabilized devices. The spectral parameters of these vibrations are estimated, too. We present simulations of the motor power component which is required for keeping quality of LOS stabilization process.

Introduction

Authors (Cech, V., Jevicky, J.) deal in the long term with research of Intelligent Optical Tracking System (IOTS), especially of Two Survey Points Range-Finding System (TSPRFS) [2, 3].

These systems can be placed on varied ground platforms – vehicles. It is required that these mobile versions of IOTS must be able to work in motion of platforms [2]. This requirement necessitates the usage of a quality stabilization of the line-of-sight (LOS).

Ones of the most important tests of operability and measurement accuracy of IOTS are tests performed during rides on the Gun (Elevation) Stabilization Bump Course (GSBC) of the Aberdeen Proving Ground (APG), i.e. GSBC– APG [1, 2]. At the present time the GSBC as a general standard is configurable in accordance with International Test Operation Procedure (ITOP) 03-2-836 (1.3.2.2). Modified GSBC-APG according the German standard [2] was built at Military Technical and Testing Institute (MTTI) in Zahorie, the Slovak Republic (www.vtsu.sk) – Fig. 1a. Its length is only c. 100 m. This implementation was used for our model of the GSBC – APG [2].

To save money and time, it is necessary to replace experiments using the real GSBC by simulations of the vehicle traverseing the GSBC. We can build special simulators or use the computer simulations only. In both cases we need the computational model of the vehicle traverse of the GSBC – APG. Therefore, we decided to create appropriate simulation models. Their basis is the model of a vehicle motion on GBSC–APG. We presented its essential characteristics and some results of performed simulations in our paper [2].

Without this model it is impossible to properly project the control loops of the servos and the other subsystems of the LOS-stabilized devices.

Summary

One of very hard problems is a proper choice of servomotors. Especially, a motor with the sufficient power needs to be chosen. It is valid for the motor power

$$P(t) = M \cdot p_{s1}(t) + \Delta P_{los}(t) \ , \qquad (1)$$

where

M [kg resp. kg/m^2] – the reduced mass of the rotor resp. the moment of inertia of the motor load,
$\Delta P_{los}(t)$ [W] – the instantaneous power dissipation,
$p_{s1}(t)$ [W/(kg resp. kg/m^2)] – effective specific power consumed for the acceleration or deceleration of movement of the controlled object together with next bound matters.

The specific power $p_{s1}(t)$ comprises two main components. The first component ensures the target tracking [3]. The second component allows the elimination of impacts of frame motions of the vehicle – the LOS stabilization. Our model allows to compute its course [2]. The example of computed courses is in the Fig. 1b.

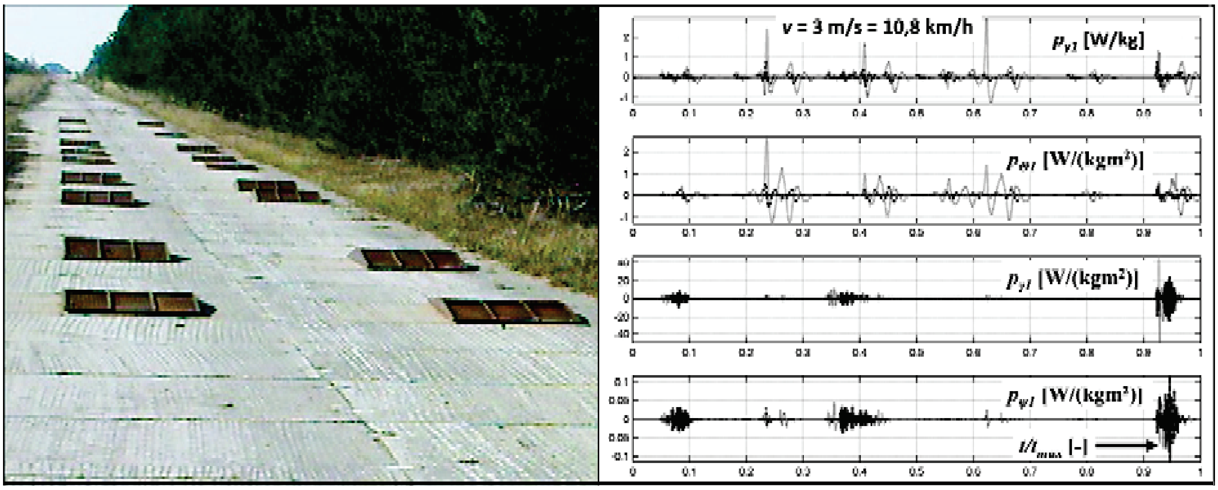

Fig. 1: a) Photo – general view on GSBC – APG built-up at MTTI in Zahorie, b) The motor power component p_{s1}, $s = y, \Theta, \gamma, \psi$ – deviations of the center of mass of vehicle suspended parts from position static equilibrium – tramp, pitch, roll and yaw. The vehicle speed is 10.8 km/h.

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