Thesis abstract:

„Source detection and shock energy determination using integrated acceleration sensors"

The dissertation is concerned with determining the sources of vibration and their characteristics in order to secure vehicles with a comfort access system. Keys for these vehicles are now standard on many vehicle makes. The comfort system has been a major gap in vehicle security, resulting in the popularity of the so-called "relay attack" theft method. The thesis of this paper is that it is possible to develop and implement a key security system for modern cars with comfortable access that operates on the basis of shock analysis.

The system will be characterised by:

- using an integrated acceleration sensor,
- non-invasive installation in the electronic key of a modern car,
- using a microcontroller with an implemented algorithm to analyse movement and decide whether to switch the electronic key off or on.

In order to prevent thefts of cars using the "relay attack" method, this thesis presents a key protection system for modern cars with convenient access, in which the power supply from the key battery is disconnected. Activation and deactivation of the power supply from the key battery is carried out by tapping the key. The developed system performs shock detection, recognises it accordingly on the basis of shock size and type. The movement of a person holding the key is also analysed. After detection and analysis, a decision is made to switch the electronic key off or on. An integrated acceleration sensor is used for shock detection.

The dissertation contains 9 main chapters as well as a Bibliography and an Appendix.

The first chapter provides an introduction to the issues at stake, describes the motivation for addressing the topic and discusses how to solve the problem.

The second chapter presents the thesis and the aim of the work.

The third chapter presents different types of integrated acceleration sensors and discusses theoretical issues related to acceleration.

The fourth chapter presents the various known anti-theft protections for vehicles that have been described in patent applications.

The fifth chapter discusses in more detail the assumptions for the way the security device works and is used, as well as its hardware implementation.

The sixth chapter is devoted to testing the adopted acceleration sensor under different conditions important to find the optimal solution to the problem and using the Fourier transform to eliminate noise.

The seventh chapter presents the IT and computing model of the device. This chapter describes all the variables, constants and procedures used.

The eighth chapter presents the different simulations carried out for the algorithms used, based on the collected measurement data for the different operating states of the key, in order to select the appropriate parameters for the operation of the algorithms.

The ninth chapter summarises the work and shows that the developed devices have been recognised by the professional automotive media both nationally and internationally.