Small pneumatic rescue cushion – modelling and simulation based on laboratory demonstrator

Blazej Poplawski*, Rami Faraj* and Krzysztof Hinc*

* Institute of Fundamental Technological Research
Polish Academy of Sciences
ul. Pawińskiego 5B, 02-106 Warsaw, Poland
Email: bpop@ippt.pan.pl, rfaraj@ippt.pan.pl, khinc@ippt.pan.pl – Web page: https://www.ippt.pan.pl/

ABSTRACT

Rescue cushions are passive devices utilized for mitigating negative outcomes of falling from heights – historically, used in evacuation of people trapped in burning buildings, nowadays mostly for assisting people jumping from heights – bungee jumping or suicide attempts. They are very similar in applications to very common automotive airbags that protect passengers during accidents. Their construction standard was established in 1980' [1] and has not changed to this day.

The requirement to be equipped with these devices is imposed on emergency services in many countries of the world because authorities recognize the fact that these are life-saving equipment. However, there are no observed scientific or engineering attempts to improve their design, or even to investigate it in a systematic manner using computer aided methods and experiments. Much effort is focused on car airbags [2], landing systems [3] or wearable airbags [4,5]. This scientific research gap has been addressed by the authors. The primary goal of the research is to improve the system's response under different impact conditions, what will result in higher safety of the equipment and greater trust to rescue cushions. In order to achieve this goal, a complex study, including modelling, simulation and experimental validation of models, is required.

Within this contribution authors discuss the procedure of elaborating a computer model of rescue cushion in CAE system. Technical details of the model, such as the material and fluid models or ground interaction, and difficulties encountered during its preparation, are discussed and explained. Research procedure is started by formulating necessary assumptions and introducing the modelling methods. Then the numerical model is implemented and validated using a laboratory demonstrator. Influence of the selected parameters on the accuracy of the model, as well as on the performance of rescue cushion system, is analysed. Biggest challenges and directions of further research are indicated.

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