



Research Trip Summary Report

Task 2. Foreign mobility of WUST doctoral students

I. Data of the doctoral student

1. Full name: *Mateusz Jacek Dymek*
2. Year of studies: *3rd year of PhD studies*
3. Educational discipline: *Mechanical Engineering*

II. Foreign research trip (research visit)

1. Research institute in which the foreign research was implemented: *University of Virginia (UVA), Center for Applied Biomechanics (CAB)*
2. Name and surname of the host person (mentor): *Matthew B. Panzer*
3. Dates of the research trip: *12.04.2023 – 12.07.2023*
4. Title and date of a seminar delivered during the research trip: *Natural cork – production, mechanical properties and application – 15.06.2023*

5. Description of work carried out during the research trip:

The research trip was dedicated to experimental helmet testing with an additional energy absorbing layer manufactured from cork. The UVA's CAB provided the linear impactor setup with accordance to the previous tests published in the literature and based on the National Football League helmet testing program. The tests were divided into 3 stages: regular American football helmet to obtain the reference data, modified helmet with cork layer between the outer shell and inside foam, regular helmet with cork layer on the outside of the shell in style of a guardian cap.

The experiments were conducted for 4 different locations of the impact according to Viano et. Al. 2012. The locations can be denoted as Front, Side Upper, Rear Upper and Rear. Since the additional absorbing layer was placed only on the inner and outer side of the shell, it was decided to perform only shell impacts. The facemask impacts were omitted for this study.

The data was analyzed in a MatLab software and based on the performance score the modifications were assessed.

6. Description of the main results obtained:

The experiment have shown that the proposed cork thickness (5mm for the inside setup) resulted in a decrease of HARM performance score in front and rear configuration for low velocity impact by roughly 27%. Front and Rear configuration for high velocity impact showed a decrease around 15%.

The experiment have shown that the proposed cork thickness (10mm for the outside setup) resulted in a decrease of HARM performance score front and rear configuration for low velocity impact by roughly 10%. Front and rear configuration for high velocity impact showed no significant decrease.

The impact configuration Side Upper and Rear Upper didn't show a significant decrease in HARM score for both high and low velocity impacts. This may be due to the specific built of the HIII neck model. The neck was designed to operate in flexion not in lateral bending. Nevertheless, this dummy is used to numerous standards worldwide, including for helmets.

7. Future collaborations (if applicable):

The near future collaboration will include the publication of results obtained during the stay. There is a mutual agreement that future helmet studies can be performed at CAB facility. Additionally, the PhD student established connections with researchers at CAB that will result in future collaborations on biomechanics, pedestrian safety and vehicle safety.

8. Title and date of a seminar presenting the results of the trip delivered at Wrocław University of Science and Technology after returning from the research trip:

Cork as an energy absorbing material in American Football – 26.07.2023

III. Doctoral student's signature

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(Date)

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(doctoral student's signature)

IV. Confirmation and information from the host

1. Confirmation of compliance of the information contained in the report: I CONFIRM / ~~DO NOT CONFIRM~~. (In justified cases, the confirmation of the host may be sent by e-mail to the Dean's Office of the Doctoral School email: interdocschool@pwr.edu.pl)

2. Additional information and comments

I hereby confirm that Mr. Mateusz Dymek conducted research on the energy-absorbing structure created from natural cork, which he has designed for use as the protecting layer in an American Football helmet. Testing was conducted at UVA's Center for Applied Biomechanics (CAB) and used equipment and procedures based on the National Football League helmet testing program.

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(Date)

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(signature(s) of Host)