Participant Information Sheet

(Version 2.0, September 1. 2021)

Title of Project: Developing advanced vibration performance assessment for new generation of lightweight pedestrian structures using motion platform and virtual reality environments

Researcher name: Dr Sigong Zhang and Dr Stana Živanović

Invitation and brief summary:

You are being invited to take part in our research project, which aims to quantify the influence of the vibrating surface (e.g., frequency, amplitude and duration) on the human walking patterns. The ultimate goal is to accurately predict the actual vibration response of pedestrian structures like footbridges. This study is funded by European Commission Horizon 2020 (H2020-MSCA-IF-2019). Before you decide whether you would like to take part, please read through the following information which will clarify why the study is being conducted, and what your involvement would be. Take time to decide whether or not you would like to participate. Please feel free to ask any questions that you may have about the study using the contact details provided at the end of the information sheet.

Purpose of the research:

Currently, the design for structural vibration induced by human walking is based on the walking forces obtained on rigid surfaces. It is largely unknown how footstep forces would be modified if the surfaces are vibrating, especially when the step frequency is near the natural frequency of pedestrian structures (e.g., footbridges). The study seeks to identify whether and how human walking behaviours over vibrating surfaces differ from walking over rigid ones, such as ground floors. The vibrations in question are in the vertical direction only. Staff and students in the University of Exeter are invited to take part.

Why have I been approached?

We would like to recruit around 12 adult participants (6 males and 6 females) with no history of walking locomotion impairments. We will describe the study in this information sheet. If you choose to participate, we will ask you to read and sign a consent form to confirm that you have agreed to take part. You will be free to withdraw at any time, without giving a reason and this will not affect you or your circumstances in any way.

What would taking part involve?

If chosen, you will be asked to take part in experiments commencing at an agreed time. You will be asked to participate in two test phases. Phase I tests will be conducted at an indoor platform (VSim) and Phase II is carried out at an outdoor footbridge. Both are located at University of Exeter Engineering Research Centre in Exeter Science Park. The scheduling of your session will be discussed and agreed between all parties involved. Your involvement in the research ends after the completion of your data collection.

Prior to tests all details will be clearly explained to you. You will be assigned a test subject number (TS#). All your information and following test data will be recorded against this number. The research investigators will be happy to provide information about the outcomes of the research at a later date to any test participant who expresses interest. Pre-test visit will be arranged to measure the physical characteristics of each subject (e.g., body mass, height and leg length). During this visit, you also have a chance to get familiar with test facilities such as such as treadmill, VSim platform, motion capture systems and metabolic measurement equipment.

On the dates of your scheduled experiments, you should come to the VSim building in the Exeter Science Park. Phase I test series involve walking over a treadmill on the vibrating platform in VSim and Phase II is walking on outside footbridge (Outside of VSim building). The bridge deck is 20 m long and 2.1 m wide and vibrates in vertical direction when crossed by a person. These vibrations might or might not be perceptible by the pedestrian who is generating them. A bridge crossing lasts between 10 s and 20 s, depending on the speed of walking. These two test phases are briefly explained here:

Phase I: you will be asked to wear a motion capture suit and walk at a selected normal walking speed on a treadmill placed at VSim platform. You will walk continuously about 30 minutes in one session. During one session, the platform will discretely vibrate and keep still. Different combinations of vibrating parameters of VSim platform will be studied and they are vibration amplitude (0 – 2 m/s^2), vibration frequency (1.5 Hz – 6 Hz) and vibration duration (5 s, 25 s and 5 min). In total, five sessions will be performed. In first and second sessions, you will also need to wear a facemask to measure the oxygen uptake. There are several different test cases depending on the vibration of VSim platform.

Phase II: you will be asked to wear a pair of insole pressure sensors and walk at different pacing rates on the footbridge. After the crossing, you will step off the bridge and return from the ground to the start point. You need to wait for vibrations to die out. This will take between 20 s and 60 s. When vibrations are sufficiently small, you will be instructed to cross the bridge and return from the ground again. This set of tests will last up to 30 min.

In all tests involving crossing the bridge you will be asked to rate how you felt during the crossing. The following categories will be available and they will be read to you by the responsible researcher:

Category 1: the vibration was imperceptible during this crossing,
Category 2: the vibration was acceptable and had no effect on the walking style,
Category 3: the vibration was acceptable and occasionally affected the walking, and
Category 4: the vibration was unacceptable and affected the walking style most of the time.

Data recorded in the Phase I on VSim are the kinematic trajectories of body markers, ground reaction forces (GRF) and metabolic cost. The data recorded in the Phase II tests on the bridge are: insole pressure, accelerations of the bridge and force at the bridge supporting points. Additionally, photographs and video records will be taken during the tests for quality assurance purposes. These will also be used in conference and research presentations, research publications and other promotions of the research to the public, but only if you provide permission for this use in the consent form.

You have right to withdraw from the study without explanation and at any point in time. This will not affect your status in any way. You can ask for break during tests, if one is needed, at any time.

During the tests, you might perceive vibrations of the platform or footbridge. In most tests, these will be at the levels comparable to what you experience when crossing bridges or other public structures. The highest vibration levels achievable on the bridge are comparable with those you might have experienced in sports or music events on grandstands, with the difference that your vibrating exposure will be short (the bridge crossing is only 10-20 s long,

depending on speed of walking, and even so the vibrations are not noticeable when you are close to the bridge supports).

What are the possible benefits of taking part?

Your participation will contribute towards the advancement of human motion science and engineering design, as we hope the results will be able to provide a greater understanding of how pedestrians interact with vibrating surfaces. The whole experimental process will be interesting. You can experience various cutting-edge testing facilities such as motion capture system, vibrating platform and metabolic measurement equipment, which may evoke your curiosity on research activities on human factors and structural engineering. You may also proactively aware your own walking behaviours. Long term, the results will ultimately help structural engineers design more sustainable and more (vibration-wise) comfortable structures.

What are the possible disadvantages and risks of taking part?

The vibrations generated on the platform and footbridge are not expected to have adverse effects on your health and wellbeing. However, if you get concerned about the vibrations perceived during testing, you should notify the responsible researcher so that test can be terminated. The walking activity to be performed during the tests does not require any special levels of fitness and it is comparable with your usual walking activities. However, if you suffer from motion sickness, any form of vibration sensitivity and/or locomotion impartment you should not take part in the tests.

What will happen if I don't want to carry on with the study?

Participation in this study is entirely voluntary. Refusal to participate will not affect you in any way. If you decide to take part you are still free to withdraw at any time and without giving a reason. A decision to withdraw at any time, or a decision not to take part, will not affect the standard of care you receive.

How will my information be kept confidential?

At the start of tests, you will be assigned a coded name such as test subject (TS1, TS2, etc…) as soon as the data collection starts. From this point on, only coded names will be used in electronic storage, for the data analysis and publication purposes. Your weight, height, age and gender will also be recorded against the coded name only. The data will be stored on a password protected computer, and the investigators and their collaborators will have access to the data.

Your name will be contained in the Consent Form only. This form will be kept in paper from only and will be locked in a drawer in the lead investigator’s office. The consent forms will be accessible by the lead investigators only, and they will be destroyed when no longer required.

Published papers may feature pictures of test subjects (those who provided written permission) to illustrate a particular aspect of the test. However, the name of the participant will not be identified and the facial features will be blurred. Video data will be used in the conference and seminar presentations as well as in promotions of the research to the public (e.g., in online illustration of the research) only if a prior written consent has been granted by the participant.

Will I receive any payment for taking part?

No expenses or payments will be made to anyone taking part in this study.

What will happen to the samples I give?

The impersonal data collected in the study will be stored indefinitely. Consent forms containing names of test participants will be stored for at least 10 years in a locked drawer to which only the lead investigator will have access. If you would like to know more about the results of the study, please contact the researchers – it is likely that one year after the study some outputs in form of conference or journal publications will be available.

What will happen to the results of this study?

It is expected that the outcomes of this study will be published in journal and conference papers and presented in posters and other domains of research dissemination. The investigators will be happy to provide you with the insight into these outputs at your request.

Who is organising and funding this study?

This project is being led by Dr. Sigong Zhang and Dr. Stana Zivanovic at the CEMPS of the University of Exeter and is funded by H2020-MSCA-IF-2019 of European Commission. Further information can be found through the link of *https://cordis.europa.eu/project/id/898216*.

Who has reviewed this study?

This study has been reviewed and given favourable opinion by the University of Exeter's Research Ethics Committee.

Further information and contact details

If you have any questions about any aspect of the study, or your participation in it, not answered by this participant information leaflet, please contact:

Research Fellow: Dr Sigong Zhang
Email: S.Zhang4@exeter.ac.uk

Associate Professor: Dr Stana Živanović
Email: s.zivanovic@exeter.ac.uk

Any complaint about the way you have been dealt with during the study will be considered. Please address your complaint to Research Ethics and Governance Office of the University of Exeter:

Gail Seymour, Research Ethics and Governance Manager
g.m.seymour@exeter.ac.uk, 01392 726621

Thank you for your interest in this project.