# Damping and vibration behaviour of flax-carbon composite bicycle racing frames

Joachim Vanwalleghem

Supervisor(s): Wim Van Paepegem, Mia Loccufier, Ives De Baere

## I. Introduction

Nowadays, bicycle racing frames are mostly made of composite materials which combine advantages such as high strength and stiffness with low density. However, a stiff frame makes the rider feel less comfortable while riding a rough surface. These advantages are achieved through using carbon fibre as reinforcement material for the composite. All bicycle frame manufacturers use this fibre, but since a few years the Flemish company Museeuw Bikes makes use of a flax-carbon reinforcement to produce their frames. They believe that the flax fibre has an advantage on the riding comfort due to its good vibration absorbing properties. In order to assess the effect of the flax fibre on the vibration behaviour of the bicycle, both the material damping and the bicycle itself are investigated.

## II. Dynamic behaviour of the bicycle

A bicycle does not only consist of a frame, but also the tires and the rider shall have a distinct effect on the dynamic behaviour of the frame. These three main parameters are examined both experimentally and numerically. The experimental test makes it possible to measure acceleration and contact force near the contact points of the rider with the frame. Also, the strain levels near critical places at the frame will be measured. The numerical model makes it possible to analyze the effect of a parameter (e.g. tire pressure) on the global dynamic behaviour, and thus on the acceleration level near the contact points. Figure 1 shows how the numerical model looks like.

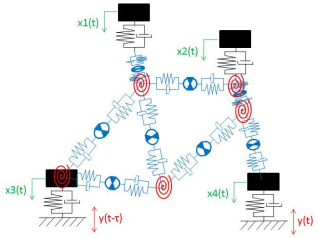


Figure 1. Numerical model of a bicycle.

## III. Effect of frame material

The material damping (and thus the effect of the flax fibre) is assessed experimentally. After an extensive study, it became clear that only contactless excitation (loudspeaker) and response measurement (laser vibrometer) of the test specimen leads to adequate and reproducible results. Some typical damping profiles are shown at Figure 2.

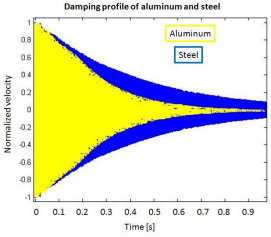


Figure 2. Acoustic excitaiton: damping profile.

J. Vanwalleghem is with the Materials Science and Engineering Department, Ghent University (UGent), Gent, Belgium, Joachim.Vanwalleghem@UGent.be