

## Project Proposal

On behalf of Tacx B.V., a Garmin Company

### Graduation project

PROJECT NAME:	<b>PROPULSION</b>
<b>FACULTY:</b>	Faculty of Maritime, Materials and Mechanical Engineering
<b>DEPARTMENT(S):</b>	<b>BMeche / PME (or other ME)</b>
<b>STUDENT PROGRAM:</b>	<b>MSc</b>
<b>STUDY PERIOD/DURATION:</b>	3Q's worth (approx. 9 months)

### Summary of the project:

In search of an accurate representation of outdoor cycling dynamics, Tacx is searching for a student who is able and enthusiastic in helping us achieve that goal.

For this project, we are interested in an accurate dynamic representation of a bicycle's forward motion resulting from the cyclist's actions: pedaling, acceleration of upper body mass and exerting forces on the bicycle's handlebars. In particular, the relation between a cyclist's exerted torque on the pedals and the resulting accelerations of a cyclist and the bicycle.

We do not need to consider the sideways, steering and rolling motions usually inherent to outdoor cycling. The bicycle and an included resistance unit at the rear wheel may be assumed fixed on a mounting mechanism with only one degree of freedom: forwards/backwards motion in direction of the bicycle frame. What we, and the student, need to find out is how a bicycle reacts to external forces during certain maneuvers: cycling while sitting, standing up and sprinting on simulated horizontal roads and try to reproduce this behavior on an indoor solution. This solution may be actively controlled, or a passive one. The challenge is to let the user experience realistic motion within the boundaries of the mechanical setup, including the freedom to move the bicycle around when no pedaling force is present.

The student may use information from previous experiments performed at Tacx in his/her tackling of this challenge. Sensor systems and processing tools are available at the company for performing experiments, as well as a wide range of existing indoor solutions and prototypes (some of which work, some which do not). Expertise on mechanical design, manufacturing, control, and actuator systems is present and available to the student to use.

If need be, this internship can be extended to a full graduation project if all parties are willing.

### Deliverables by the student:

In this study, the student will try to deliver:

- A literature study on the topic of forward cycling dynamics, including dependencies on a cyclist's posture, position and control actions.
- A detailed description of the concept development process and final concept, in terms of usual mechanical engineering process tools (morphological overview, theoretical model, proposal for validation).
- If time allows, a prototype (manufacturing capability provided by the company) of the picked concept and validation through measurement of a range of cyclists and

### We look for...

A student with an enthusiastic attitude towards cycling, preferably with cycling aptitude and a pre-existing understanding of cycling dynamics. If you're someone who is able to work independently, but accepting of constructive criticism, all the better!

Followed courses by the student with a focus on multibody dynamics, control loop design and analysis, sensor dynamics or human body dynamics are preferred, as well. Previous applied experience on these topics in terms of projects part of the curriculum, or work experience is always a nice thing to have.

### We offer...

A place in the innovation, research and development department at Tacx where you will be surrounded with experienced engineers, working on state-of-the-art technologies in mechanical, electrical and software engineering. You will be able to work with them, learn from their expertise and gain experience in a research and development environment.

A monetary compensation of €350,- (gross) per month is offered for your work here.

Daily supervision of an assigned supervisor is available, as well as a flexible workplace at our location in Oegstgeest.

### Contact information:

#### Principal contact:

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## About the company

Tacx B.V., acquired in 2019 by Garmin, has been a company ever involved with cycling, cyclists and bringing innovation to the cycling world. Starting as a family cooperation in 1957, and actively starting production of indoor cycling trainers in 1969, Tacx has been at the forefront of technological advancements in indoor cycling equipment.

Today, Tacx is still a visible part of the professional cycling world, being a partner of WorldTour-, Pro-Continental and Continental teams, as well as other cycling teams, triathletes, mountain-biking and ice skating professionals.



A large contributing factor in the success of Tacx as a company are the fact that nearly all products are Made in the Netherlands. This allows for a shorter supply chain, quick assessment of possible improvements and greater quality control.

With the main office and production facilities situated in Oegstgeest since 2020, Tacx remains an ever-expanding and growing company constantly looking for enthusiastic engineers and developers to become a part of the innovation team.

Being an engineer at Tacx, and at Garmin, means becoming an owner of the technologies we develop, and demonstrate transparency about our products performance.

