



# Project Proposal

## Project Management and Software Development for Medical Applications

### General Info

Project Title: Reducing the orthopaedic risk of cycling with a vision-based anthropometric scanner

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### Project Abstract

The goal of this project is to develop a software prototype that helps to avoid the most common cycling injuries by reducing the medical risk caused by incorrect posture on the bike. This is done by means of a computer vision based software tool that extracts anthropometric data from images.

### Background and Motivation

Every year, more than 1.3 million people are medically treated due to bicycle-related injuries. Besides accidents, a large part of patients suffers from particular orthopaedic disorders such as Achilles Tendonitis, Patellar Tendonitis or lower back (or neck) pain.

Many of these long lasting problems are difficult to treat efficiently in short time or the diagnosis to facilitate a full recovery had had to be at a much earlier stage. A proper adjustment of the bicycle parts and the individual fit of the cycle geometry to the anthropometric measures of the cyclists can avoid most of these injuries.

However, currently the adjustment process is often a matter of trial and error and especially the unexperienced cyclist does not know whether a position can be improved or is potentially non-ergonomic. The project partner FRAMOS now

wants to bridge this gap by using a computer vision based approach to extract the relevant anthropometric data and adjust the bicycle according to the individual measurements of both unexperienced cyclists and athletes.

### Student's Tasks Description

The target for the student is to establish a (semi-) automatic software tool to extract in a first step the anthropometric data of a person based on an acquisition of one or several images with a webcam. A second step – for which also a graphical user interface is needed – is the processing of the anthropometric data and the calculation of the bicycle adjustment that fits the best to the individual proportions of the cyclist.

For this complete task to be tackled, a 3D measurement functionality has to be implemented based on recent publications in the field of computer vision and multiple image analysis. Since the extrinsic geometry of the scene has to be mapped to a measurable geometry, a context-aware procedure to facilitate the calibration has also to be developed so that it is applicable in a defined measuring process.

After this project, the student is able to understand and implement an algorithm presented in a recent publication in the field of computer vision and can organise different software elements which are integrated into a bigger software framework. Moreover, the constant coordination with FRAMOS gives some insight into the working procedures in the industry.

Please send the completed document to [okur@in.tum.de](mailto:okur@in.tum.de) before the project proposal deadline on April 1<sup>st</sup>, preferably earlier. Please note that this proposal will be evaluated by the BMC coordinators and will be assigned to a student only in case of acceptance.



## Technical Prerequisites

- Basic knowledge of MATLAB / C++
- Basic skills in linear algebra

Optional requirements that can also be learned during the project are:

- Basic knowledge of image processing
- 2D/3D computer vision expertise
- Some basic understanding of projective geometry
- Experience with GUI-Programming (MATLAB / Qt)
- Ability to work with versioning tools such as SVN / GIT
- Software architecture for projects of larger scale

## References

Leutenegger, Stefan, Margarita Chli, and Roland Yves Siegwart. "BRISK: Binary robust invariant scalable keypoints." *Computer Vision (ICCV), 2011 IEEE International Conference on*. IEEE, 2011.

Zhang, Zhengyou. "A flexible new technique for camera calibration." *Pattern Analysis and Machine Intelligence, IEEE Transactions on* 22.11 (2000): 1330-1334.

Silberman, Marc R., et al. "Road bicycle fit." *Clinical Journal of Sport Medicine* 15.4 (2005): 271-276.

Sauer, Julie L., et al. "Influence of gender, power, and hand position on pelvic motion during seated cycling." *Medicine and science in sports and exercise* 39.12 (2007): 2204.