University of Stuttgart

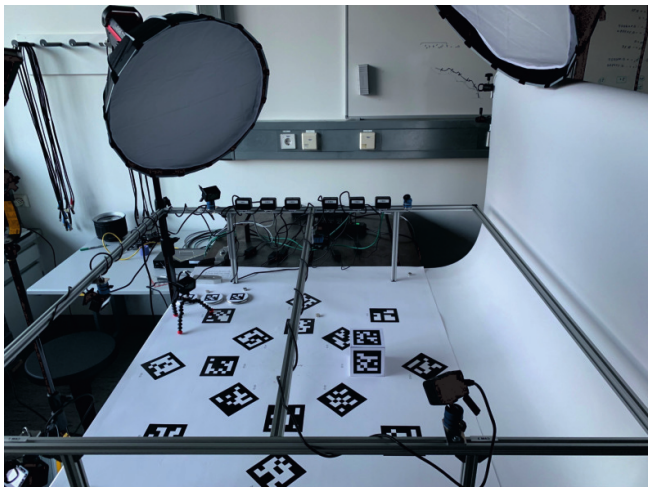
Institute for Nonlinear Mechanics

Bachelor's thesis
Term paper
Master's thesis

Design and Construction of an Object Tracking Benchmark System

Topic Areas:	Technical Design, Electronics 3D Printing, Hardware Programming
Advisors:	Tianxiang Dai, dai@inm.uni-stuttgart.de Jonas Breuling, breuling@inm.uni-stuttgart.de
Responsible Professor:	Prof. Remco Leine
Prerequisites/Prior Knowledge:	Interest in Hardware Design, Electronics and Hardware Programming

To measure the pose or motion of moving objects, object tracking systems provide a convenient solution. These systems only require attaching small black-and-white markers to the objects, avoiding the need for expensive measurement devices that require power sources. Combined with off-the-shelf consumer cameras, this approach offers a cost-effective alternative to commercial systems. By utilizing the state-of-the-art OpenCV [1] computer vision library, the position and orientation of the markers can be accurately determined.



To estimate the motion of an object, data from multiple markers and cameras must be processed [2]. A variety of computer vision algorithms can be applied for this purpose. Therefore, a benchmark system will be designed and built as part of this thesis to evaluate the performance of the different algorithms, providing valuable insights into their suitability for real-world applications.

This thesis aims to design and build an object tracking benchmark system that can be used to validate the performance and accuracy of the applied computer vision algorithms. Specifically, the goals of this thesis are

- design of the object tracking benchmark system, including the selection of the necessary hardware components, their construction and 3D printing
- assembling of the system's hardware and electronics
- development of a motion capture system that detects the position and orientation of the markers using OpenCV [1]
- develop a benchmark policy that evaluates the performance and accuracy of the camera setup in combination with the applied computer vision algorithms

The overall goals of this project will be adjusted based on the thesis type.

References

[1] G. Bradski, "The OpenCV Library," *Dr. Dobb's Journal of Software Tools*, 2000.

[2] T. Amosa *et al.*, "Multi-camera multi-object tracking: A review of current trends and future advances," *Neurocomputing*, 2023.