



University of Stuttgart

Institute for Nonlinear Mechanics

Bachelor's thesis  
Term paper  
Master's thesis

Design and  
Construction of  
an Automated Maze  
Ball Game

Topic Areas:	Technical Design, Electronics 3D Printing, Hardware Programming
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Responsible Professor:	Prof. Remco Leine
Prerequisites/Prior Knowledge:	Interest in Hardware Design, Electronics and Hardware Programming

The CyberRunner project introduced in [1] is based on the popular maze ball game and breaks the current world record using machine learning techniques.



CyberRunner [1], ETH Zurich

Besides this fascinating performance, the project is an interesting hardware platform that can be used as an attractive technical demonstrator for research related to nonlinear and nonsmooth mechanics as modeling, control and machine learning. Thereby, it encompasses challenging issues in hardware design, electronics and hardware programming.

This thesis aims to design and build an automated maze ball game, similar to the Cyber-

Runner. Specifically, the goals of this thesis are

- design of the automated maze ball game, including the selection of the necessary hardware components, construction and 3D printing of the motor adapters
- assembling of the system's hardware and electronics
- programming of a simple joystick interface to control the motion of the game board
- development of a motion capture system that detects the position of the ball using OpenCV [2]
- motion control of the ball on a flat game board without walls
- identification of the restitution coefficient between the ball and the board
- simulation of the ball game dynamics

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

## References

- [1] T. Bi and R. D'Andrea, *Sample-efficient learning to solve a real-world labyrinth game using data-augmented model-based reinforcement learning*, 2023.
- [2] G. Bradski, "The OpenCV Library," *Dr. Dobb's Journal of Software Tools*, 2000.