Institute of Machine Components and Methods of Development

Demonstrator for a Guided Recovery System

Construction, building and testing of a guided recovery system implemented in a sounding Rocket

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Abstract

Until now, it has not been possible for the Aerospace Team Graz (ASTG) to determine the landing point of their rocket, which has made recovery difficult. The aim of this Bachelor's thesis is to prove that a controlled landing is possible using a controllable parachute, by implementing a demonstrator in the nosecone of ISPIDA, a sounding rocket developed for the 2025 EuRoC, capable of reaching an altitude of 9 km.

In addition to the fundamental principles, this thesis addresses the concept phase, which comprises not only the individual concepts but also the requirements that defined the decision-making process. Following, the design phase was undertaken, covering the structural elements of BUBO, the mission name for the guided nosecone, along with the corresponding calculations. Subsequently, the individual components were manufactured and assembled. Finally, a test campaign was developed.

With BUBO, it was demonstrated that a parachute control system can be successfully implemented within the limited space of the nosecone. The project also established a foundation for future efforts to integrate controllable parachutes into upcoming ASTG rockets, while providing a fundamental understanding of their operation.

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Statutory Declaration

I declare that I have authored this thesis independently, that I have not used other than the declared sources / resources, and that I have explicitly marked all material which has been quoted either literally or by content from the used sources.

Date and Signature

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1 Introduction

The Aerospace Team Graz (ASTG) is an interdisciplinary student club comprising members from various universities in Graz, Austria. The team focuses on developing and building sounding rockets for international competitions such as the European Rocketry Challenge (EuRoC). [9]

Until now, the landing point of the entire rocket has been unpredictable, as the parachute lacks controllability. As a result, the landing position is influenced by wind conditions and the rocket's flight trajectory. This poses significant challenges for rocket recovery, especially given that parts of the EuRoC launch site are densely wooded. Additionally, the rough and inaccessible terrain makes on-foot recovery challenging and time consuming.

1.1 Task definition

The primary objective of this thesis is to develop and realize a control unit for a steerable parachute and successfully integrate it into the nosecone of a 9 km sounding rocket. This involves several key stages, including the conceptual design, dimensioning, and testing of the control system to ensure its functionality and reliability.

Beyond the technical development, this thesis also aims to evaluate the overall feasibility of such a system. By demonstrating its effectiveness, the findings will serve as a foundation for future advancements. In the long term, the system is intended to be further refined and scaled up, ultimately enabling guided recovery of the entire rocket body, not only the nosecone.

1.2 Approach

The thesis follows the same schedule as the rocket ISPIDA and is therefore not decoupled, as some coordination and interfaces have to be harmonised with the project on an ongoing basis.

This bachelor thesis is structured into three main phases. The concept phase, which began in November 2024, focused on defining requirements and the creation of an initial layout in the form of a block diagram. Furthermore, concepts for technical implementation were created and evaluated in this phase. Next, the design phase, which started in January 2025, involved the technical realization and calculations, ensuring compliance with the established requirements. Finally, the testing phase, which started in Spring 2025, evaluated the system's functionality and verified that it meets all specified criteria.