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Model Predictive Control for Autonomous Vehicles: A Simulation-Based Approach

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Graz, March 2025

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Datum

Unterschrift

List of Acronyms

NASA National Aeronautics and Space Administration

Kurzfassung

Kurze Beschreibung des Inhalts.

Abstract

Brief outlook on the content of this document.

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Chapter 1

Introduction

Content of the Introduction. The Introduction 1 holds a figure 1.1, a figure 1.2 and cites something [1]. Afterwards it continues with chapter 2. The National Aeronautics and Space Administration (NASA) was founded in 1958. The NASA is known for its space missions.

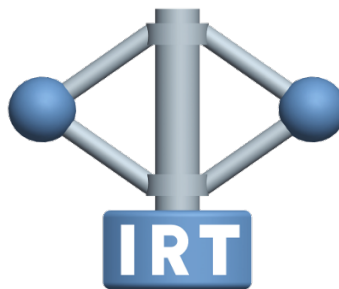
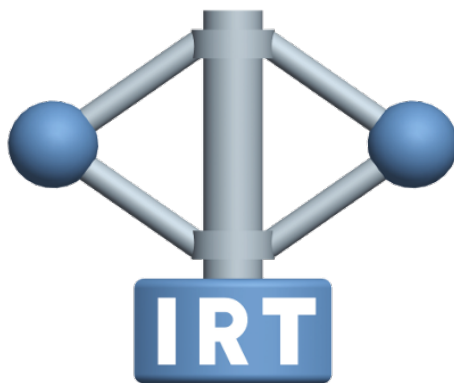


Figure 1.1: Long caption text



(a) Caption figure A



(b) Caption figure B

Figure 1.2: Overall caption

1.1 Background

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1.1.1 Sub-section 1

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1.2 Problem Statement

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Chapter 2

Methodology

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2.1 A table

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Table 2.1: Constants of a system

| Parameter | Value | Unit |
|-----------|--------|------------------------------|
| m | 0.19 | kg |
| k | 0.2 | $\frac{\text{kg}}{\text{s}}$ |
| c | 4.8398 | $\frac{\text{N}}{\text{m}}$ |

2.2 Some equations

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$$\frac{d\mathbf{x}}{dt} = \mathbf{A}\mathbf{x} + \mathbf{b}u, \quad y = \mathbf{c}^T \mathbf{x} + du.$$

$$\begin{bmatrix} \mathbf{x}_{k+1} \\ u_k \end{bmatrix} = \underbrace{\begin{bmatrix} \mathbf{A}_d & \mathbf{\Gamma}_1(\tau_a, \tau_b) \\ \mathbf{0} & 0 \end{bmatrix}}_{=:\mathbf{A}_\xi(\tau_a, \tau_b)} \underbrace{\begin{bmatrix} \mathbf{x}_k \\ u_{k-1} \end{bmatrix}}_{=\boldsymbol{\xi}_k} + \underbrace{\begin{bmatrix} \mathbf{\Gamma}_0(\tau_a, \tau_b) \\ 1 \end{bmatrix}}_{=\mathbf{b}_\xi(\tau_a, \tau_b)} u_k, \quad (2.1)$$

$$y_k = [\mathbf{c}^T \quad 0] \boldsymbol{\xi}_k,$$

$$\begin{aligned}
\begin{bmatrix} \mathbf{x}_{k+1} \\ u_k \\ u_{k-1} \\ \vdots \\ u_{k-\zeta+1} \end{bmatrix} &= \underbrace{\begin{bmatrix} \mathbf{A}_d & \Gamma_1(\mathbf{Y}) & \dots & \Gamma_{\zeta-1}(\mathbf{Y}) & \Gamma_{\zeta}(\mathbf{Y}) \\ \mathbf{0} & 0 & \dots & 0 & 0 \\ \mathbf{0} & 1 & \dots & 0 & 0 \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ \mathbf{0} & 0 & \dots & 1 & 0 \end{bmatrix}}_{=:\mathbf{A}_{\xi}(\mathbf{Y})} \underbrace{\begin{bmatrix} \mathbf{x}_k \\ u_{k-1} \\ u_{k-2} \\ \vdots \\ u_{k-\zeta} \end{bmatrix}}_{=:\boldsymbol{\xi}_k} \\
&+ \underbrace{\begin{bmatrix} \Gamma_0(\mathbf{Y}) \\ 1 \\ 0 \\ \vdots \\ 0 \end{bmatrix}}_{=:\mathbf{b}_{\xi}(\mathbf{Y})} u_k, \tag{2.2} \\
y_k &= [\mathbf{c}^T \quad 0 \quad 0 \quad \dots \quad 0] \boldsymbol{\xi}_k.
\end{aligned}$$

2.3 Theorem

2.3.1 Theorem 1

Theorem 3.1: Pythagoras' theorem

In a right triangle, the square of the hypotenuse is equal to the sum of the squares of the catheti.

$$a^2 + b^2 = c^2$$

In mathematics, the Pythagorean theorem, also known as Pythagoras' theorem, is a relation in Euclidean geometry among the three sides of a right triangle.

2.3.2 Theorem 2 with proof

Theorem 3.2

There exist two irrational numbers x, y such that x^y is rational.

Proof 3.1

If $x = y = \sqrt{2}$ is an example, then we are done; otherwise $\sqrt{2}^{\sqrt{2}}$ is irrational, in which case taking $x = \sqrt{2}^{\sqrt{2}}$ and $y = \sqrt{2}$ gives us:

$$\left(\sqrt{2}^{\sqrt{2}}\right)^{\sqrt{2}} = \sqrt{2}^{\sqrt{2}\sqrt{2}} = \sqrt{2}^2 = 2.$$

List of Figures

| | | |
|-----|---------------------------------|---|
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| 1.2 | Short overall caption | 1 |

List of Tables

2.1 Constants of a system 4

Bibliography

- [1] P. Peter, “Latex: A document preparation system,” *Software: Practice and Experience*, vol. 23, no. 10, pp. 141–152, 1995.