

Thesis submitted in fulfilment of the requirements for the award of the degree of Doctor of ... (Doctor in de ...)

TITLE OF PHD

Your Name

May 7, 2024

Promotor: Prof. Dr. ir. ? Co-promotor: Prof. Dr. ir ?

Jury: Prof. Dr. ir. ?, chairman

Prof. Dr. ir. ?, vice-chairman

Dr. ir. ?, secretary

Random dude (university somewhere)

Faculty of ...
Department of ...

Acknowledgement

I would like to thank \dots

Your Name

Abstract

Give here a short summary of your work

List of abbreviations

Below, the list of abbreviations that has been used throughout this thesis, can be found. This list is made per chapter to show where each abbreviation appears first. No new entry will be made if a certain abbreviation returns in a later chapter.

Chapter 1

SPECTA Series Parallel Constant Torque Elastic Actuation

SEA Series Elastic Actuation PEA Parallel Elastic Actuation VSA Variable Stiffness Actuation SPEA Series Parallel Elastic Actuation

+SPEA Series Parallel Elastic Actuation with multiple parallel branches

ispea intermittent Series Parallel Elastic Actuation

DMA Dual Motor Actuation
DOF Degrees Of Freedom

SMES Superconducting Magnetic Energy Storage

CAES Compressed Air Energy Storage pHRI Physical Human-Robot Interaction NBM Non Backdrivable Mechanism

CT Constant Torque

Chapter 2

CTM Constant Torque Mechanism

ZTS Zero Torque Shift

CFM Constant Force Mechanism

Chapter 4

HRI Human-Robot Interaction

Brushless Direct Current

PMSMPermanent Magnet Synchronous MachinePMACPermanent Magnet Alternating Current

PSGTParallel Shaft Gear Train Planetary Gear Train PGTHDHarmonic Drive Cycloid Drive CDBSBall Screw WGWave Generator FSFlexspline Circular Spline CSECEccentricity Cam Cycloid Disc CD

RR Ring rollers with ring gear

OD Output Disc

List of symbols

Below, the list of symbols that has been used throughout this thesis, can be found. This list is made per chapter to easily find the meaning for each symbol.

Standard Symbols

Standard Symbols	
T	Torque
θ	Angle
K	Spring Stiffness
F	Force
m	Mass
V	Volume
J	Mass moment of inertia
I	Area moment of inertia
d	Diameter
L	Length
t	Thickness
σ	Stress
E	Module of elasticity
b	Width
I	Motor Current
R	Armature Resistance

Standard Subscripts

i	Input
o,out	Output
spring.spr	Spring
mech	Mechanical
min	Minimum
max	Maximum

Q

 $\begin{array}{ll} L_0 & \quad & \text{Initial length} \\ \Delta L & \quad & \text{Axial compression} \\ \theta_L & \quad & \text{Left inclination angle} \\ \theta_R & \quad & \text{Right inclination angle} \end{array}$

Chapter 3

 A_{spring} The torque level of a constant torque spring

 R_1 R_2

 r_0

Minimal required distance between the axes of the drums of a constant torque sp

Chapter 4

 r_{gap} Gap radius

 k_t Motor torque constant

n Number of wires in the cross-section

H Magnetic field strength

Motor mass m_m Motor inertia J_m Armature radius r_a Rotor length l_a Motor radius r_m Motor length l_m Armature density ρ_a N Reduction ratio

C Utilization factor of the machine

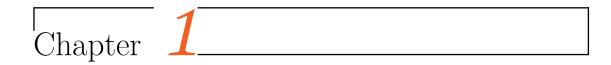
 $egin{array}{ll} B_e & & {
m Air gap flux density} \\ lpha & {
m Pole coverage factor} \\ A & {
m Linear current density} \\ \end{array}$

 w_a Number of armature windings

 T_{stall} Stall torque

 ho_w Specific winding resistance l_w Total length of the winding

Contents



Introduction

Give here the introduction...

1.1 Research questions

The goal of this dissertation is to \dots

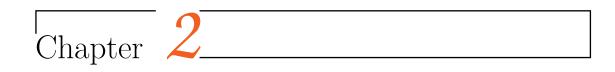
This is divided into several separate research questions:

- Question 1?
- Question 2?
- Question 3?
- Question 4?
- Question 5?

1.2 Outline of the thesis

The doctoral thesis is divided into... (give here overview of the thesis)

Part I First Part



First real chapter

2.1 Introduction

Put here the introduction

2.2 Conclusion

Give here the conclusion of the first chapter

Part II Part two

Second chapter

Part III Conclusion

Conclusion and future work

- 4.1 General conclusions
- 4.1.1 Question 1?
- 4.1.2 Question 2?
- 4.1.3 Question 3?
- 4.1.4 Question 4?
- 4.1.5 Question 5?
- 4.2 Future work

Appendix A

List of publications

Publications which are submitted for review, or which are not listed in Scopus (such as poster presentations or publications in journals not listed in Scopus), are listed in grey.

Articles in scientific journals with an international referee system

Ι.	

2. ...

3. Last Name, A., Co-author, B., ..., & Last author, C. (2019). Name of paper. Name of Journal, edition number.

Review articles in scientific journals with an international referee system

1. ...

Interational conference papers

1. ...

2. ...

International conference and symposium abstracts and/or posters

1. ...

2. ...