T2R2 東京科学大学 リサーチリポジトリ
Science Tokyo Research Repository

論文 / 著書情報
Article / Book Information

題目(和文)	
Title(English)	Design and Control of Single and Parallel Soft Pneumatic Helical Deformation Actuators
著者(和文)	YUANPeizheng
Author(English)	Peizheng Yuan
出典(和文)	学位:博士(工学), 学位授与機関:東京工業大学, 報告番号:甲第12536号, 授与年月日:2023年9月22日, 学位の種別:課程博士, 審査員:塚越 秀行,三平 満司,倉林 大輔,鈴森 康一,髙山 俊男
Citation(English)	Degree:Doctor (Engineering), Conferring organization: Tokyo Institute of Technology, Report number:甲第12536号, Conferred date:2023/9/22, Degree Type:Course doctor, Examiner:,,,,
学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	要約
Type(English)	Outline

Powered by T2R2 (Science Tokyo Research Repository)

論文要約

YUAN Peizheng

TABLE OF CONTENTS

ABSTRACT

ACKNOWLEDGEMENT

TABLE OF CONTENTS

NOMENCLATURE

1 INTRODUCTION

1.1 Background

1.2 Research purpose

1.3 Related works

1.3.2 Contraction/extension SPAs

1.3.3 Bending SPAs

1.3.4 3-dimensional twisting SPA

1.4 Contribution of this research

1.5 Thesis outline

2 SHA: SINGLE HELICAL ACTUATOR

2.1 Introduction of the single helical actuator (SHA)

2.2 Actuator desig

2.3 Driving principle

2.4 Characteristics

2.5 Modeling

2.5.1 Deformation with no load

2.5.2 Deformation with load

2.6 Experiments

2.7 Application

2.8 Chapter conclusion
3 DHA: DOUBLE HELICAL ACTUATOR
3.1 Design philosophy of DHA
3.2 Introduction of the DHA-I
3.3 Working principle of the DHA-I
3.3.1 Basic driving principle
3.3.2 Motion 1: Bi-directional screwing
3.3.3 Motion 2: Curving
3.3.4 Motion 3: Screwing and curving
3.4 Fabrication of the DHA-I
3.5 Experiments of the DHA-I
3.5.1 Experiment methods
3.5.2 Experiments on motion 1: Bi-directional screwing
3.5.3 Experiments on motion 2: Curving
3.5.4 Experiments on motion 3: Screwing and curving
3.6 Applications of the DHA-I
3.7 Introduction of the DHA-II
3.8 Working principle of the DHA-I
3.8.1 Mechanical design of the DHA-II
3.8.2 Working principles of six motion patterns
3.9 Fabrication of the DHA-II
3.10 Modeling of the DHA-II
3.11 Experiments of the DHA-I
3.12 Application of the DHA-II
3.13 Discussion on DHA-II
3.14 Chapter conclusion
4 DIRECT KINEMATICS AND INVERSE KINEMATICS OF DHA-II

4.1 Controllability of DHA-II
4.1.1 Vector metho
4.1.2 6 output parameters
4.1.3 3-dimensional spiral deformation
4.1.4 3-dimensional helical deformation
4.1.5 2-dimensional partial bending
4.1.6 2-dimensional reverse bending
4.1.7 2-dimensional bending
4.1.8 1-dimensional extension
4.1.9 Energy efficiency
4.1.10 DOF of DHA-I
4.2 Direct Kinematics of the DHA-II
4.2.1 Simulation with gravity
4.3 Inverse kinematics of the DHA-II
4.3.1 Sensing system
4.3.2 Geometric method without gravit
4.3.3 Solution with gravity
4.4 Chapter conclusion
5 CONTROL SYSTEM OF DHA-II
5.1 Manual control system
5.2 Automatic control system
5.3 Chapter conclusion
6 CONCLUSION
6.1 Summary
6.2 Further Development
REFERENCES
RESEARCH ACHIEVEMENT