論文 / 著書情報
Article / Book Information

題目(和文)	
Title(English)	Shape-changing and Variable-stiffness Interface using Pneumatic Actuators
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出典(和文)	学位:博士(学術), 学位授与機関:東京工業大学, 報告番号:甲第12594号, 授与年月日:2023年9月22日, 学位の種別:課程博士, 審査員:小池 英樹,三宅 美博,徳永 健伸,金﨑 朝子,下坂 正倫
Citation(English)	Degree:Doctor (Academic), Conferring organization: Tokyo Institute of Technology, Report number:甲第12594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)	論文要旨
Type(English)	Summary

（博士課程）
Doctoral Program

論 文 要 旨

THESIS SUMMARY

系・コース： Department of, Graduate major in	Computer Science 系 コース	申請学位（専攻分野）： Academic Degree Requested	博士 (Philosophy) Doctor of
学生氏名： Student's Name	Jefferson Pardomuan	審査員主査： Chief Examiner	Hideki Koike

要旨（英文 800 語程度）
Thesis Summary (approx.800 English Words)

Shape-changing interface is an ongoing multi-disciplinary study that has great promise for future application. Despite the possibilities, entry to shape-changing interface research is challenging due to the required knowledge of both complex electronics and mechanical engineering. These complexities increase exponentially when physical properties such as variable-stiffness are added into the systems. This research focuses on the development of a framework for prototyping shape-changing and variable-stiffness interfaces using pneumatic actuation. The aim is to facilitate the creation of interfaces with intuitive, lightweight, cost-effective, and scalable tools.

Chapter One provides an introduction to the research, including an overview of the existing issues in shape-changing interfaces and the motivation behind developing prototyping tools for such interfaces.

Chapter Two reviews related works in shape-changing and variable-stiffness mechanisms, as well as existing prototyping tools for shape-changing interfaces. The positioning of the proposed research is also discussed in relation to previous works.

Chapter Three explains the common framework underlying the research, highlighting the benefits of pneumatic actuation and how it connects the ClaytricSurface and ASTRE mechanisms.

Chapter Four introduces the ClaytricSurface system, which focuses on exploring the use of variable-stiffness displays for 2.5D modeling. The basic mechanism of Vacuum Jamming is investigated, and its application in an interactive display with graphical input-output is demonstrated. Various use cases and features to support shape modeling and painting applications are showcased.

Chapter Five addresses the limitations of ClaytricSurface, particularly its active deformation capabilities, and presents the ASTRE mechanism as a solution. ASTRE is a programmable shape-changing and variable stiffness mechanical constraint for PAMs actuators. The characteristics of each module are examined, and the design space, fabrication workflow, and hardware control system are described.

Chapter Six introduces the ASTRE Toolkit, a prototyping tool that utilizes the ASTRE mechanism and employs a constructive assembly system. The chapter discusses a constructivist approach to shape-changing interfaces and presents design guidelines for deformation properties, haptic properties, and shape-tuning capabilities. The toolkit is demonstrated through various applications, including educational toys, deployable artifacts, and soft robots. The chapter also includes a technical evaluation of shape tuning.

Chapter Seven focuses on VabricBeads, a design exploration for shape-changing and variable-stiffness fabric. The application of the ASTRE mechanism in fabric structures is explored, resulting in the synthesis of 12 types of fabrics. The chapter presents three sensing techniques to enhance the fabric with interactive capabilities and showcases the usability of such fabrics in wearables and decorative applications.

Chapter Eight provides insights, findings, and discussions on the systems and applications described in Chapters Four, Five, Six, and Seven (ClaytricSurface, ASTRE mechanism, ASTRE Toolkit, and VabricBeads). The advantages and limitations of each system are summarized and analyzed. The chapter also discusses the overall findings and contributions of the research framework and presents

potential future applications.

By addressing the complexity barriers and providing accessible tools, this research aims to empower designers and researchers to explore the possibilities of shape-changing interfaces and pave the way for their widespread adoption.

備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).

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