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論文 / 著書情報
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題目(和文)	フィルム状可動子をもつ薄形コンパクトリニアスイッチトリラクタンスモータの運動制御と計測
Title(English)	Motion Control and Measurement of a Thin and Compact Linear Switched Reluctance Motor with a Film Mover
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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10921号, 授与年月日:2018年6月30日, 学位の種別:課程博士, 審査員:進士 忠彦,初澤 毅,吉田 和弘,吉岡 勇人,只野 耕太郎,佐藤 海二
Citation(English)	Degree:Doctor (Engineering), Conferring organization: Tokyo Institute of Technology, Report number:甲第10921号, Conferred date:2018/6/30, 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

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Thesis outline

Thesis title: Motion control and measurement of a thin and compact linear switched reluctance motor with a film mover

1. Introduction

Firstly, the background of this study is described including the characteristics, applications and state of research of switched reluctance motors (SRMs). The newly developed linear switched reluctance motor (LSRM) and its application example are introduced. The LSRM has advantages, for example, a thin and compact shape, easy to disassemble/assemble, an easily exchangeable and disposable mover. However, it has a strong nonlinear driving characteristic that presents a challenge with respect to precision positioning and motion. Furthermore, for the ease of replacing and disposing, the mover without any sensor parts on it is desirable. Therefore, the research purpose is (1) to realize precise positioning by compensating the nonlinear characteristic; (2) to realize precise motion by overcoming the problems resulting from the fluctuating and limited thrust force characteristic; and (3) to realize motion measurement without the need to add sensor parts on the mover.

2. Design of precision positioning control system

This chapter describes the precise positioning control of the thin and compact LSRM with a film mover. The dynamic model derived for simulating the nonlinear driving characteristics is explained. The positioning results and the problem associated

with the conventional PID control system are described. Then, the control system with the proposed linearizer unit is designed and the positioning performance of the control system is examined. For comparison, the conventional PID controller and the PID controller with the basic linearizer unit are also shown to better visualize the beneficial effect of the designed control system.

3. Design of precision motion control system

This chapter describes a suitable motion system design method for the developed LSRM that has a small effective thrust force and validate its usefulness. First, the positioning control system that includes the proposed linearizer unit is improved with additional control elements. To show the beneficial effect of the designed control system, other control systems without additional control elements are compared together in the motion experiments. The robustness of the control system for precise motion against influences of the length and mass variation in the movers is examined experimentally. Furthermore, the robustness of the control system to a sudden load and speed variation is verified. Then, the limitations of the motion performance are clarified. Lastly, the temperature of the coils by the motion control system is measured to know the extent of the temperature rise at the time of driving.

4. Motion measurement without additional element on the mover

This chapter describes the motion measurement of the developed LSRM without additional element on the mover. A motion measurement system without any sensor parts on the mover is proposed. Initially, the design of the proposed measurement

system in terms of its configuration, principle and signal processing are described in detail. Then, the experimental setup including the LSRM prototype and proposed measurement system are explained. The experimental results involving the validation of the measurement accuracy are described. At the end, motion performance of the control system using the proposed measurement system as a feedback sensor is examined experimentally.

5. Conclusions and future works

Finally, this chapter presents the conclusions and a few recommendations for future works.