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# **Study of Noise Reduction of Switched Reluctance Motor in Traction and Industrial Applications**

自動車駆動用および産業用スイッチドリラク  
タンスモータの騒音低減

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# **Study of Noise Reduction of Switched Reluctance Motor in Traction and Industrial Applications**

A THESIS SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND  
ELECTRONIC ENGINEERING AND THE COMMITTEE OF GRADUATE  
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Supervisor: Prof. Akira Chiba

By

Candra Adi Wiguna

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## ABSTRACT

This thesis discusses two methods to reduce acoustic noise in switched reluctance motors. These methods are radial force sum flattening for traction 18/12 switched reluctance motor and a novel concept of selective radial force harmonics reduction for 6/10 switched reluctance motor for industrial application.

In case of radial force sum flattening, this thesis describes the improvement of the implementation from only low speed to middle speed operation by considering limited input DC voltage and high back electromotive force into the calculation process of current derivation. The effectiveness of the method is verified both in finite element analysis and experiment. The experimental results show a significant reduction by the improved current in the highest and second-highest peaks of noise at 5.4 kHz and 1.8 kHz by 11.04 dBA and 17.51 dBA, respectively, compared with a conventional single pulse current. The other peaks of noise are also reduced. By flattening radial force sum in middle speed, the overall noise reduction of 3.64 dBA is achieved.

In case of the second method, a novel method for vibration and acoustic noise reduction in a three-phase 6/10 switched reluctance motor is presented. The test machine has major vibration and acoustic noise at the 2<sup>nd</sup>, 4<sup>th</sup>, 5<sup>th</sup>, 7<sup>th</sup>, and 8<sup>th</sup> harmonics. Accordingly, a novel method called “selective radial force harmonic reduction” is proposed. The proposed method selectively reduces the specific radial force harmonics at the stator teeth. By reducing the specific radial force harmonics such as 2<sup>nd</sup>, 4<sup>th</sup>, 5<sup>th</sup>, 7<sup>th</sup>, and 8<sup>th</sup>, the corresponding vibration and acoustic noise can be reduced significantly in the test machine. Finite element analysis and experiments are conducted to verify the effectiveness of the proposed method. Compared with a conventional square current, the experimental results show that the overall sound pressure level is reduced by 7.1 dBA using the proposed method at the rated speed and torque. The dynamic conditions of the test machine using the proposed method are also presented.

# LIST OF CONTENTS

ACKNOWLEDGMENT .....	i
ABSTRACT .....	iii
LIST OF CONTENTS .....	iv
LIST OF FIGURES .....	vii
LIST OF TABLES .....	xi
1. INTRODUCTION .....	1
1.1. Demand of Electric Machine.....	1
1.2. Electric Machine in Market.....	2
1.2.1. Electric Motor for Traction Application .....	2
1.2.2. Electric Motor for Industrial Application .....	7
1.3. The Objective of the Thesis.....	8
1.4. Contents of Thesis .....	9
2. PRINCIPLE OF SWITCHED RELUCTANCE MOTOR AND LITERATURE REVIEW .....	10
2.1. Switched Reluctance Motor: Principle and Development.....	10
2.1.1. Excitation of SRM in High Speeds .....	14
2.1.2. Continuous Operation of SRM.....	15
2.1.3. Development of Switched Reluctance Motor for A Traction Motor .....	16
2.2. Acoustic Noise Problem in SRM .....	18
2.3. Literature Review .....	19
2.3.1. Noise Reduction in SRM by Improvement of Motor Structure.....	19
2.3.2. Noise Reduction in SRM by Voltage and Current Profiling.....	23
3. IMPROVED CURRENT PROFILE SELECTION FOR NOISE REDUCTION OF SWITCHED RELUCTANCE MOTOR AT MIDDLE SPEED CONSIDERING BACK EMF.....	34
3.1. Introduction .....	34
3.2. Specification of 18/12 SRM.....	34
3.3. Challenge of Radial Force Sum Flattening for SRM in Middle Speed Operation.....	36
3.4. Proposed Procedure of Current Calculation.....	37

3.5.	Nonlinear Inductance and Its Approximation .....	41
3.6.	Verification of Proposed Procedure .....	44
3.7.	Finite Element Analysis Result of Radial Force Sum Flattening in Middle Speed .....	45
3.8.	Experimental Verification .....	48
3.8.1.	Experimental Setting.....	48
3.8.2.	Radial Force Sum Flattening in Downscaled Operating Point .....	50
3.8.3.	Measurement at 3000 rpm with The Input DC Voltage of 300V ...	52
3.9.	Improvement of RMS current of The Proposed Method .....	57
3.9.1.	Adding turn-on and turn off angles.....	57
3.9.2.	Increasing the harmonics of current waveform.....	59
3.10.	Summary .....	60
4.	VIBRATION AND ACOUSTIC NOISE REDUCTION IN SWITCHED RELUCTANCE MOTOR BY SELECTIVE RADIAL FORCE HARMONICS REDUCTION .....	61
4.1.	Introduction .....	61
4.2.	The Specification of 6/10 SRM.....	61
4.3.	Principle of The Radial Force Sum Flattening and Selective Radial Force Harmonics Reduction.....	62
4.4.	Current Calculation for Proposed Method .....	65
4.5.	Finite Element Analysis .....	70
4.6.	Experimental Verification .....	73
4.7.	Further Verification of Method 3 .....	78
4.8.	Summary .....	85
5.	INVESTIGATION OF EFFECTIVE CONDITIONS OF RADIAL FORCE SUM FLATTENING FOR ACOUSTIC NOISE REDUCTION IN SWITCHED RELUCTANCE MOTORS .....	86
5.1.	Introduction .....	86
5.2.	Specifications, Dimensions, and Fixation Settings of Three-phase SRMs .....	86
5.2.1.	Case of Three-phase 18/12 SRM .....	86
5.2.2.	Case of Three-phase 24/16 SRM .....	88
5.2.3.	Case of Three-phase 12/8 SRM .....	88
5.3.	Verification of Radial Force Sum Flattening .....	89

5.3.1.	Measurements in 18/12 SRM.....	89
5.3.2.	Measurements in 24/16 SRM.....	92
5.3.3.	Measurements in 12/8 SRM.....	94
5.4.	Summary .....	95
6.	CONCLUSION AND OUTLOOK OF RESEARCH.....	96
6.1.	Conclusion.....	96
6.2.	Outlook of Research.....	97
6.2.1.	Mechanical Analysis and Measurement of SRM towards Vibration and Acoustic Noise Characteristic.....	97
6.2.2.	Implementation of Selective Radial Force Harmonics Reduction to Other SRM Topologies.....	99
	REFERENCES.....	102
	LIST OF PUBLICATIONS .....	110
	AWARDS .....	111

## LIST OF FIGURES

Figure 1.1 Global electricity consumption in 2011.....	1
Figure 1.2 Projection of electric vehicle sales. ....	2
Figure 1.3 Torque – rotational speed profile of electric motor of traction application. ....	3
Figure 1.4 Topology of battery and fuel cell electric vehicles.....	3
Figure 1.5 Topologies of hybrid electric vehicles: (a) series, (b) parallel, and (c) combined. ....	4
Figure 1.6 IEC standard of efficiency class of electric motor.....	8
Figure 2.1 Cross section of SRMs.....	10
Figure 2.2 Illustration of SRM operation in one electrical period. In (a) C-phase is aligned and A-phase is excited, (b) A-phase is aligned and next B-phase is ready for excitation. ....	11
Figure 2.3 Excitation of the conventional square current at low speed. (a) current $i$ , (b) flux linkage $\lambda$ , (c) torque $T$ , and (d) flux – current curve.....	11
Figure 2.4 Relationship between flux linkage with current and rotor rotational position. ....	13
Figure 2.5 Excitation of the conventional square current at high speed. (a) current $i$ , (b) flux linkage $\lambda$ , (c) torque $T$ , and (d) flux – current curve.....	14
Figure 2.6 Three-phase inductances, currents, and generated torques for continuous operation. ....	15
Figure 2.7 Cross section of PMSM and SRM.....	16
Figure 2.8 Comparison of iron loss of 35A300 and 10JNEX900.....	17
Figure 2.9 Cost comparison of material of PMSMs and SRMs.....	17
Figure 2.10 Sources of acoustic noise in SRM. ....	18
Figure 2.11 The Illustration of acoustic noise and vibration generation by radial forces. ....	19
Figure 2.12 SRM structure with added windows or holes in a rotor and a stator. ....	20
Figure 2.13 Radial force of SRMs of conventional and added window on rotor and stator poles. ....	20
Figure 2.14 Inserted spacer between stator teeth in SRM.....	21
Figure 2.15 Cross section of conventional SRM and SRM with skewed structures. ....	22
Figure 2.16 Conventional and cylindrical rotors for acoustic noise and windage loss reductions in traction SRM. ....	23
Figure 2.17 Voltage and vibration resultant by conventional switching. ....	24
Figure 2.18 Voltage and vibration resultant by active vibration cancellation. ....	25
Figure 2.19 (a) Cross section of 18/12 switched reluctance motor, (b) radial force sum flattening concept. ....	26

Figure 2.20 (a) FEA of current $i_A$ , and (b) radial force sum $F_{rsum}$ by conventional square and proposed currents. ....	27
Figure 2.21 Radial force stator pole and its approximation (a) $F_{rA}-\theta$ (b) $F_{rA}-i$ . ....	28
Figure 2.22 The approximation of $K_{r0}$ and $K_{r1}$ by polynomial function of $i$ . ....	29
Figure 2.23 Torque and its approximation (a) $T_A-\theta$ (b) $T_A-i$ . ....	30
Figure 2.24 Measured conventional square and proposed currents. ....	32
Figure 2.25 Measured sound pressure level by conventional square and proposed currents at 1000 rpm, 10 Nm.....	32
Figure 2.26 Block diagram of DIFC control implementation.....	33
Figure 3.1 Dimension of 18/12 SRM.....	35
Figure 3.2 Current waveforms for flattening radial force sum in the 18/12 SRM at (a) 1000 rpm and (b) 5000 rpm. ....	36
Figure 3.3 Calculated back electromotive force of current waveform of the 18/12 SRM at rotational speed of 5000 rpm. ....	37
Figure 3.4 Proposed procedure of current profile derivation.....	40
Figure 3.5 Curve of flux linkage and current $\lambda - i$ of 18 slots – 12 poles SRM. ..	42
Figure 3.6 Approximation of nonlinear inductance of 18 slots – 12 poles SRM (a) $L(\theta,i) - \theta$ and (b) $L(\theta,i) - i$ . ....	42
Figure 3.7 Verification of the proposed procedure of current derivation. (a) current waveform and (b) radial force sum. ....	44
Figure 3.8 Comparison of (a) driving current, (b) back electromotive force, and (c) radial force sum of the single pulse, previous, and improved currents at 5000 rpm. ....	46
Figure 3.9 FEA results of acoustic noise by single pulse and improved currents at 5000 rpm. ....	48
Figure 3.10 Test system configuration.....	49
Figure 3.11 Experimental setup. ....	50
Figure 3.12 (a) Current for acoustic noise reduction at 1000 rpm and 3000 rpm, (b) calculated back electromotive force $V_{emf}$ , of FEM current at 3000 rpm, (c) comparison of single pulse and improved currents at 3000 rpm, 10Nm, and (d) comparison of radial force sum by single pulse and improved currents at 3000 rpm. ....	51
Figure 3.13 Measured currents at the operating point of 3000 rpm, 10 Nm, and the input dc voltage of 300V.....	53
Figure 3.14 Comparison of FEM result of (a) torque and (b) radial force sum waveforms at 3000 rpm and 10 Nm, by the measured single pulse and improved current waveforms.....	55
Figure 3.15 Comparison of measured noise of single pulse and improved currents at 3000 rpm, 10 Nm, and the input dc voltage of 300V.....	56
Figure 3.16 The radial force and torque by constant DC current and the improved current for flattening the radial force sum in middle speed. ....	58
Figure 3.17 Adding turn-on and turn-off angles in the current waveform for reducing the RMS value.....	59

Figure 4.1 (a) Cross-section of the 6/10 SRM and (b) radial forces at stator teeth $F_{rA}$ , $F_{rB}$ , and $F_{rC}$ .	62
Figure 4.2 Current waveforms by conventional square, radial force sum flattening, and selective radial force harmonics reduction.	64
Figure 4.3 Radial force waveforms $F_{rA}$ and spectra of $F_{rA}$ generated by current waveforms of methods 1, 2, and 3 in Figure. 4.2.	65
Figure 4.4 Flowchart of the current derivation for method 3.	66
Figure 4.5 FEA result of current waveforms by methods 1, 2, and 3 at 4.8 Nm, 1800 rpm.	71
Figure 4.6 FEA results of (a) radial force waveform $F_{rA}$ , (b) harmonics of $F_{rA}$ , and sound pressure level by methods 1, 2, and 3 at the rated speed and torque of 1800 rpm and 4.8 Nm, respectively.	72
Figure 4.7 Test system configuration.	74
Figure 4.8 Experimental setup of the SRM.	75
Figure 4.9 Measured currents of methods 1, 2, and 3 at rated speed and torque of 1800 rpm and 4.8 Nm, respectively.	75
Figure 4.10 Measured vibration and sound pressure level by methods 1, 2, and 3 at rated speed and torque of 1800 rpm and 4.8 Nm, respectively. Data up to (a) 3000 Hz and (b) 10,000 Hz.	77
Figure 4.11 Waterfall diagrams of measured sound pressure level by (a) method 1 and (b) method 3 at rated torque of 4.8 Nm and 100–1800 rpm.	79
Figure 4.12 Comparison of measured overall sound pressure level by methods 1 and 3 at 4.8 Nm and 100–1800 rpm.	80
Figure 4.13 Measured torque and three-phase current waveforms by methods 1 and 3 at 4.8 Nm and 60 rpm.	81
Figure 4.14 Dynamic conditions obtained by applying sudden changes of speed from 900 to 1800 rpm with increments of 300 rpm. (a) Measured rotational speed, torque, current, and vibration waveforms; (b) Enlarged view of current waveforms obtained by method 1.	82
Figure 4.15 Dynamic conditions realized by applying sudden changes of speed from 900 to 1800 rpm with increments of 300 rpm. (a) Measured rotational speed, torque, current, and vibration waveforms; (b) Enlarged view of current waveforms obtained by method 3.	83
Figure 5.1 Test machine of 18/12 SRM (a) Dimension, (b) motor fixation, and (c) mechanical design.	87
Figure 5.2 Test machine of 24/16 SRM.	88
Figure 5.3 Test machine of 12/8 SRM. (a) Cross section, (b) motor fixation, and (c) mechanical design.	89
Figure 5.4 Measured currents by the conventional and proposed currents in the 18/12 SRM at 10 Nm and 1000 rpm.	90
Figure 5.5 Measured sound pressure level by the conventional and proposed currents in the 18/12 SRM at 10 Nm and 1000 rpm.	91

Figure 5.6 Waterfall diagram of measured acoustic noise in the 18/12 SRM by (a) the conventional and (b) proposed currents at 10 Nm, from 500– 3000 rpm. ....	91
Figure 5.7 Measured currents by the conventional and proposed currents in the 24/16 SRM at 135 Nm and 800 rpm. ....	93
Figure 5.8 Measured sound pressure level by the conventional and proposed currents in the 24/16 SRM at 135 Nm and 800 rpm. ....	93
Figure 5.9 Measured currents in the 12/8 SRM by (a) the conventional and (b) proposed currents at 1.5 Nm and 1000 rpm. ....	94
Figure 5.10 Measured sound pressure level in the 12/8 SRM by the conventional and proposed currents at 1.5 Nm and 1000 rpm. ....	95
Figure 6.1 Force excitation of radial force harmonics in 18/12 SRM. ....	98
Figure 6.2 FEA result of vibration at multiples of the 3 <sup>rd</sup> harmonic in 18/12 SRM. ....	100
Figure 6.3 FEA result of acoustic noise in 18/12 SRM by the single pulse current at 3000 rpm and 10 Nm.....	100
Figure 6.4 Implementing the selective radial force harmonics reduction to 18/12 SRM. ....	101

## LIST OF TABLES

Table 1-1 Lists of implemented electric machines in market .....	6
Table 1-2 Summary of comparison of PMSM and SRM for traction application..	7
Table 1-3 Electric motor with efficiency class of IE4 or above. ....	8
Table 3-1 Specification of 18/12 SRM. ....	35
Table 3-2 Parameter of Improved Current .....	47
Table 3-3 Parameter of Improved Current at 10 Nm, 3000 rpm, and input DC voltage of 300 V .....	52
Table 3-4 Comparison of losses and efficiency of SRM at 10 Nm, 3000 rpm, and input DC voltage of 300 V .....	54
Table 3-5 Comparison of Losses and Efficiency of Three Current Waveforms...	59
Table 4-1 Criteria of current selection in step 3 of method 3. ....	68
Table 4-2 Example of Calculation Results of Current for Proposed Method at 1800 rpm, 4.8 Nm. ....	69
Table 4-3 Comparison of FEA Results of Losses and Efficiency of Three Methods at 1800 rpm and 4.8 Nm.....	71
Table 4-4 Comparison of Measured Losses and Efficiency of Three Methods at 1800 rpm and 4.8 Nm. ....	76
Table 5-1 Comparison of Losses and Efficiencies of Conventional Square and Proposed in the 18/12 SRM. ....	90