Investigation of the Effects of Parasitic Components on Parallel and Series Connected Modular Motor Drives

Abstract: In this paper, the effect of parasitic inductances on power semiconductor device stress, DC link capacitor current ripple and DC link voltage ripple in a motor drive are investigated. A GaN based motor drive inverter module designed for an Integrated Modular Motor Drive (IMMD) application is considered. The actual capacitor current stress in a single module is shown to be much more adverse when the commutation inductances are taken into account. The change in the interleaving scheme is discussed when the connection inductances between inverter modules that are connected in series or parallel are considered. A comparison between series and parallel connection in a modular motor drive is performed with several aspects.

1 Introduction

Why and where modular motor drives are studied and important Modlere geiteki ama (avantajlar), yaratlan zorluklar

IMMD application lardan bahsedelim =¿ integration ile birlikte rnekleri var

Series and parallel connection investigation in literature Seri paralele neden ihtiya duyuluyor

Parasitic investigations in literature

Interleaving applications in literature

In this paper, what we are going to do.... [1].

Biz de IMMD yapyoruz

2 Description of the Integrated Modular Motor Drive System

Bizim IMMD'yi anlatalm (drive taraf, mimari ve PCB yaps)

Ratingler tablosu

2.1 GaN based motor drive module

Bizim 1 modl fotosu, yapsn anlatalm

GaN vurgusu yaplacak

Capacitor nasl seildi + temel tasarm vurgular

2.2 Parasitic inductances

Inductance figr, notationlar ve anlatm

Power loop inductances

Phase commutation inductances

Dc bus modelimiz

2.3 Series and Parallel Connection

Seri ve paralel baant nasl oluyor (figr koyalm)

Module connection inductances - notation-figr ve anlatm

3 Investigation of a Single Inverter Module

3.1 Effect on Power Device Stress

Neden GaN kullanyoruz, GaN olunca burda nasl bir zorluk olutu?

Teorisinden bahsedelim =¿ Ldi/dt

Power loop sadece etken

Experimental resultlar (Vds overshoot) =¿ A ve B faz karlatrlabilir

Skntl durumda neler yaplabilir? (hangi parametreler etken)

3.2 Effect on DC link Capacitor Stress

Distributed capacitor architecture var (1 modl = 3 cap)

Power loop etken deil

Phase commutation inductance varken ve yokken voltage ve current datalar (simulation)

Farkl fazlarda farkl olmas (akm peakleri ile ilikisi)

Stress sharing olay ve arada doan farkn nemi

Mmknse voltage ripple experimental datas

4 Investigation of Series and Parallel Connection

Modler yapya dair motivasyon (ksaca)

4.1 Series Connection

Neden seri balarz?

Simulasyon sonucu (voltaga current ripple)

Connection inductance etkilemiyor

Interleaving aslnda etkilemiyor (Vdc ripple a etkisini gsterelim)

Wempece gnderme yaplacak

4.2 Parallel Connection

Interleaving varken ve yokken ne oluyor =¿ akm geileri

Kapasitr asndan normalde hem akm hem voltaj ripple dm olmas bekleniyor (MU'ya ref verile-cek).

Connection inductance varken ve yokken akm ve voltaj ripple lar. Beklenen interleaving etkisi olmuyor.

RMS akmlar inductance vary ederek verelim

Akm geilerinin potansiyel problemleri

4.3 Discussions

Serinin potansiyel skntlar

Serinin avantajlar ve dezavantajlar

Seride interleaving aslnda efektif olarak etken deil

Paralelde ideal durumdakinin daha bile ktsne gidebilir

Paralelin avantajlar

ok sayda modl olsa ne olurdu (seri)

ok sayda modl olsa ne olurdu (paralel)

5 Conclusion

Deductions:

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In the final paper:

fsw etkisi incelenebilir

Analitik model?

IMMD'miz var. retiyoruz test ediyoruz. Hem seri hem paralel balanabiliyor.

Kapasitr voltajlar iin deney sonucu vercez (akm lemeyiz onu derive etcez?)

Seri paralel deney sonular

Modller aras akm geileri llebilir aslnda (seri /paralelde)

References

[1] K. Wang, X. Yang, L. Wang, and P. Jain, "Instability Analysis and Oscillation Suppression of Enhancement-Mode GaN Devices in Half-Bridge Circuits," *IEEE Transactions on Power Electronics*, vol. 33, no. 2, pp. 1585–1596, 2018.