A BRIEF REPORT ON PERMANENT MAGNET ASSISTED SYNCHRONOUS RELUCTANCE MOTORS

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XP14DES

Structure of the report:

- Introduction,
- Design,
- Control,
- Comparison to other machines,
- Recent research interest.

PMSynReIM

actively used in automotive and traction aplications

control strategies based on known principles

may use relatively simple mathematical model for control

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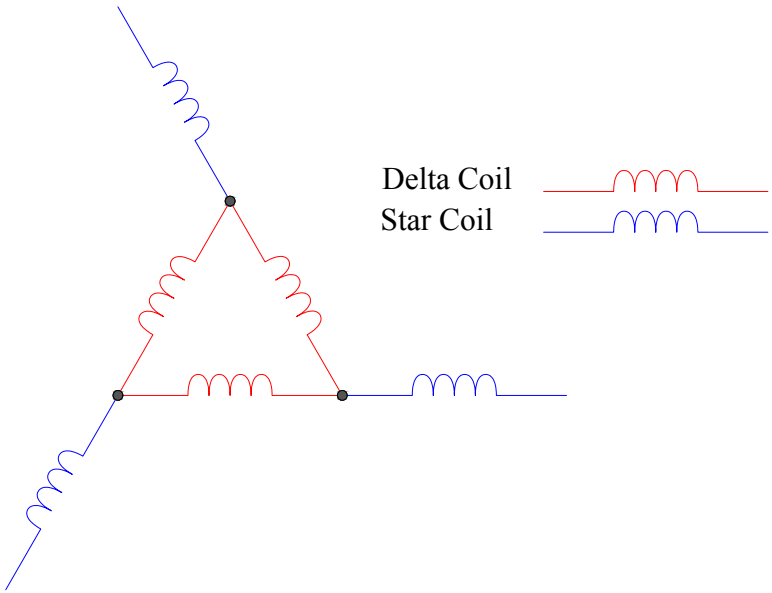
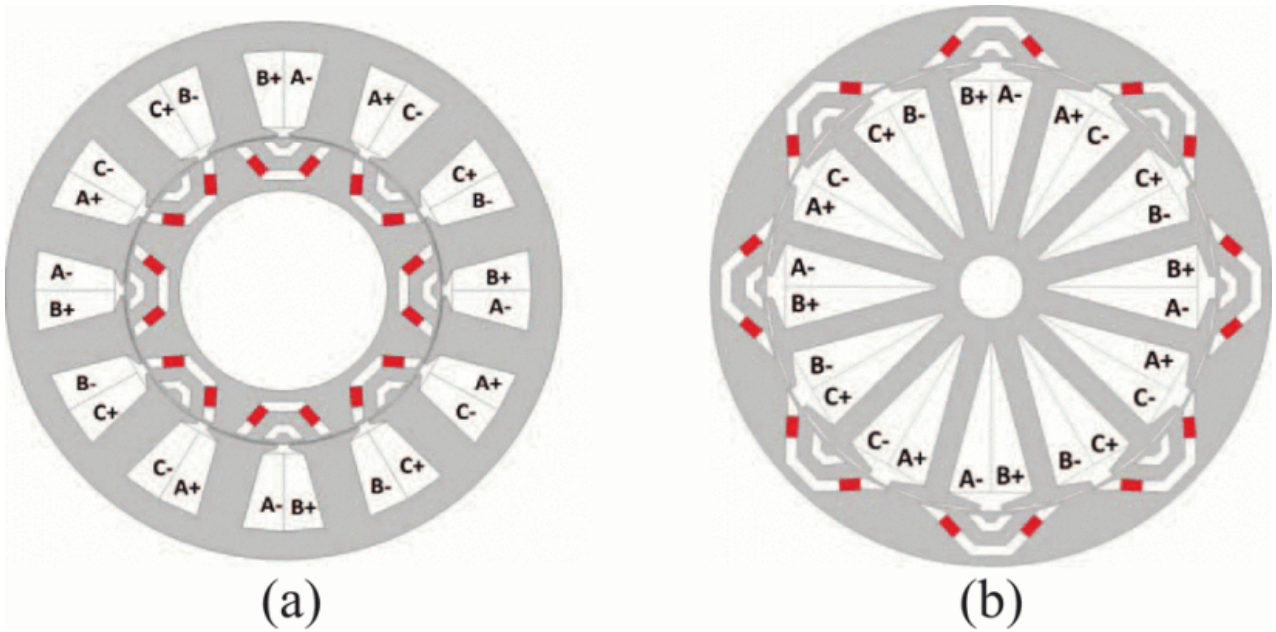
Stator

- Delta winding
- Star winding
- Star-Delta hybrid winding



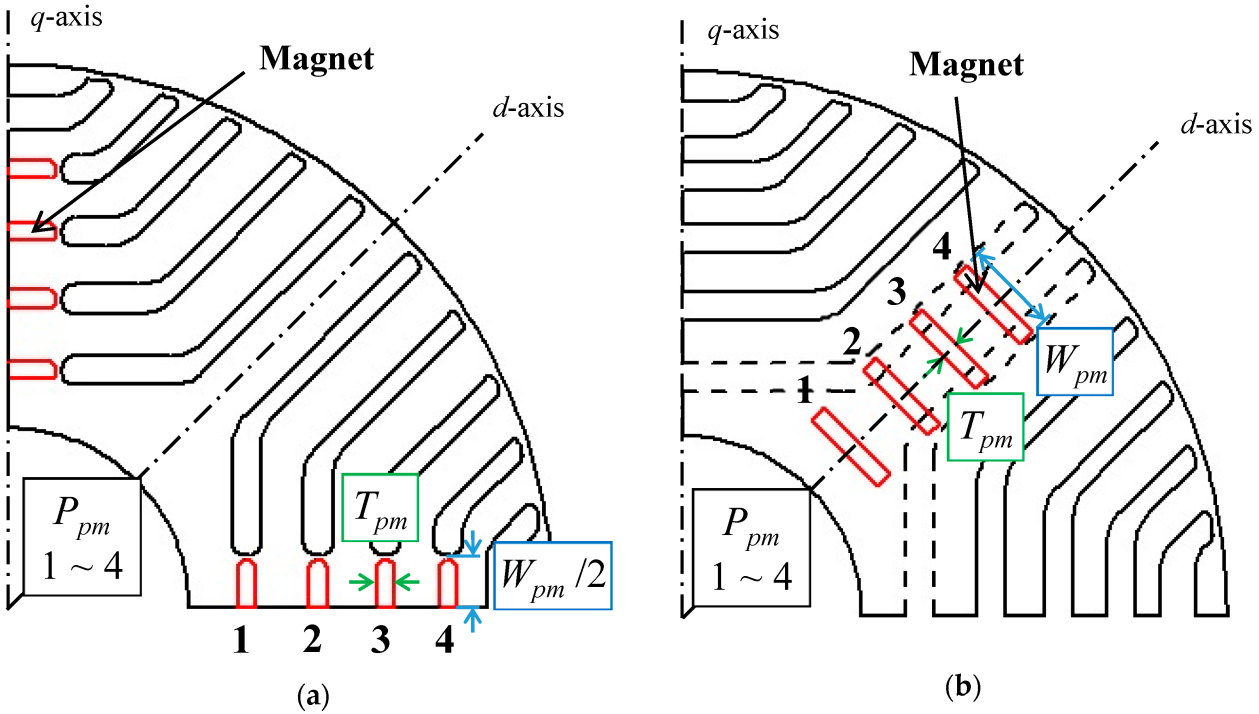
Rotor

- internal/external
- power factor/wide power range => saliency ratio (L_d/L_q)
- shape/placement/number of flux bariers
- magnets - rare earth (with neodymium/dysprosium), non-rare earth (ferrites)



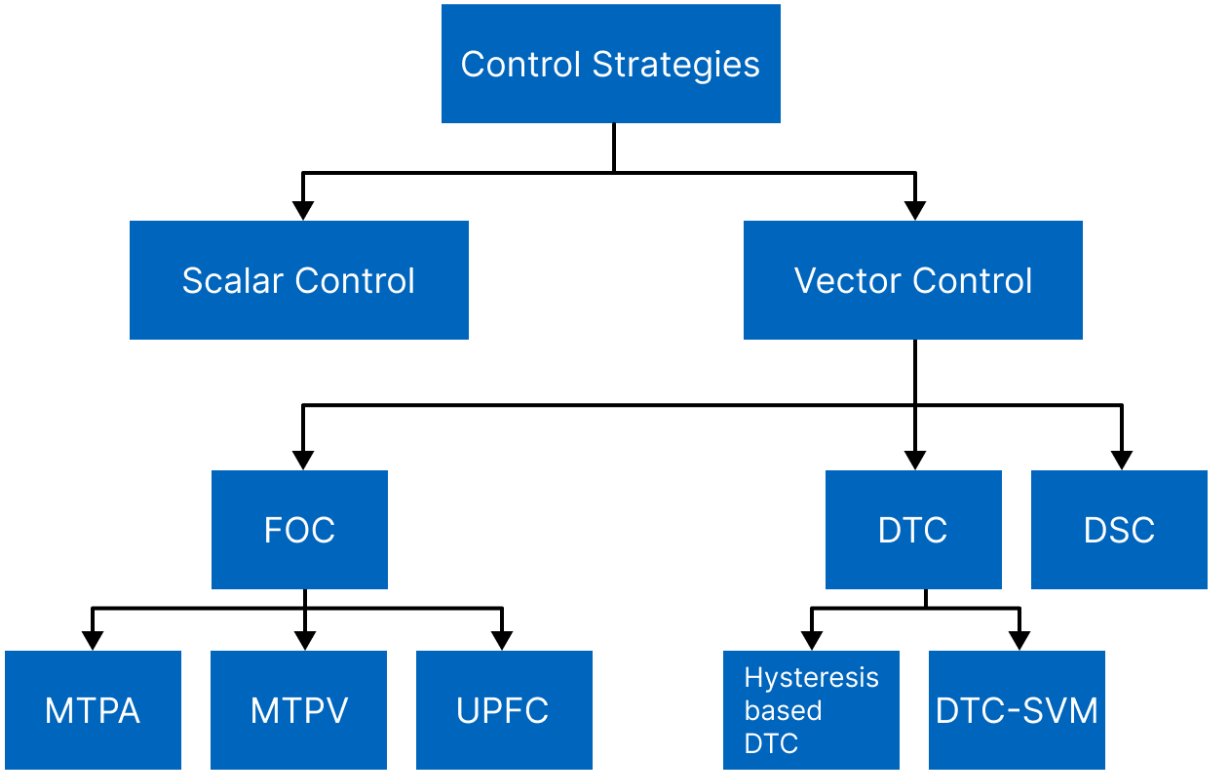
BONTHU, Sai Sudheer Reddy; CHOI, Seungdeog; GORGANI, Aida; JANG, Kibong. Design of permanent magnet assisted synchronous reluctance motor with external rotor architecture. In: 2015 IEEE In- ternational Electric Machines & Drives Conference (IEMDC). Coeur d'Alene, ID: IEEE, 05/2015, pp. 220–226. ISBN 978-1-4799-7941-7. Available from DOI: 10.1109/IEMDC.2015.7409063.

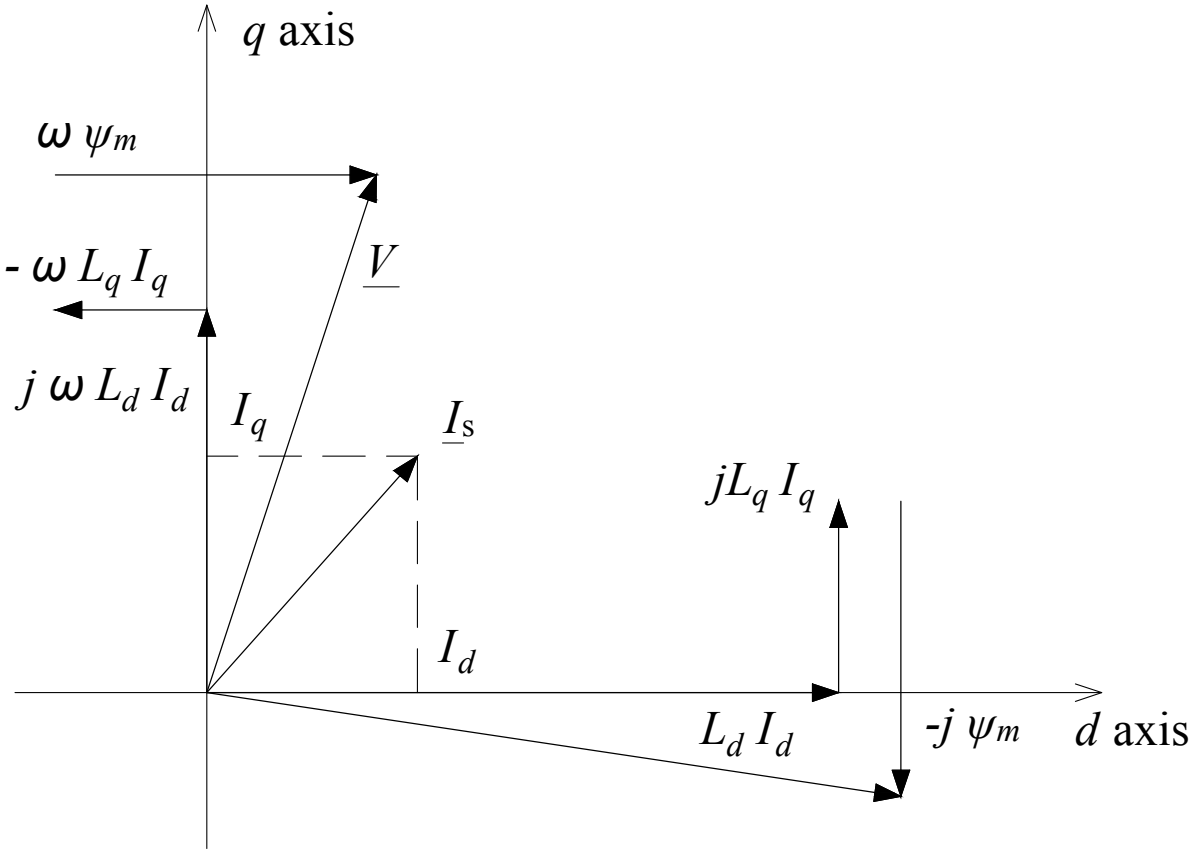
- embedded along the flux barriers, facing the *q*-axis (a) (improvement of torque)
- crossing the flux barriers, facing the *d*-axis (b)



NGO; HSIEH. Performance Analysis of Synchronous Reluctance Motor with Limited Amount of Permanent Magnet. Energies. 09/2019, roč. 12, č. 18, p. 3504. ISSN 1996-1073. Available from DOI: 10.3390/en12183504.

Control


Control Strategies
Scalar Control
Vector Control
FOC
DTC
DSC
MTPA
MTPV
UPFC
Hysteresis based DTC
DTC-SVM



$$T = \frac{3}{2}\mathrm{p_p}|\underline{\psi_{dq}} \times \underline{i_{dq}}| = \frac{3}{2}\mathrm{p_p}(\psi_d i_q - \psi_q i_d). \tag{1}$$

$$T = \frac{3}{2}\mathrm{p_p}(\mathrm{L}_d i_d i_q - (\mathrm{L}_q i_q - \psi_{\mathrm{PM}}) i_d) = \frac{3}{2}\mathrm{p_p}(\mathrm{L}_d i_d i_q - \mathrm{L}_q i_q i_d + \psi_{\mathrm{PM}} i_d). \tag{2}$$

Recent improvement was achieved:

- by using non-rare earth materials such as ferrites,
- by using novel hybrid stator winding structures,
- by analyzing rotor structure types and motor parameters based on the permanent magnet position and perfecting the design for the specific application,
- improving control strategies,
- variable flux motor (strategy).

Thank you for your attention.