

References

- [1] P. Pillay and R. Krishnan, “Application characteristics of permanent magnet synchronous and brushless dc motors for servo drives,” *IEEE Transactions on industry applications*, vol. 27, no. 5, pp. 986–996, 1991.
- [2] C.-L. Chiu, Y.-T. Chen, Y.-L. Liang, and R.-H. Liang, “Optimal driving efficiency design for the single-phase brushless dc fan motor,” *IEEE Transactions on Magnetics*, vol. 46, no. 4, pp. 1123–1130, 2010.
- [3] M. Andriollo, M. De Bortoli, G. Martinelli, A. Morini, and A. Tortella, “Design improvement of a single-phase brushless permanent magnet motor for small fan appliances,” *IEEE Transactions on Industrial Electronics*, vol. 57, no. 1, pp. 88–95, 2010.
- [4] M. Fazil and K. Rajagopal, “Development of external rotor single-phase pm bldc motor based drive for ceiling fan,” in *Power Electronics, Drives and Energy Systems (PEDES) & 2010 Power India, 2010 Joint International Conference on*. IEEE, 2010, pp. 1–4.
- [5] Z. Huang and J. Fang, “Multiphysics design and optimization of high-speed permanent-magnet electrical machines for air blower applications,” *IEEE Transactions on Industrial Electronics*, vol. 63, no. 5, pp. 2766–2774, 2016.
- [6] Z. Kolondzovski, A. Arkkio, J. Larjola, and P. Sallinen, “Power limits of high-speed permanent-magnet electrical machines for compressor applications,” *IEEE transactions on Energy Conversion*, vol. 26, no. 1, pp. 73–82, 2011.
- [7] Y.-H. Yeh, M.-F. Hsieh, and D. G. Dorrell, “Different arrangements for dual-rotor dual-output radial-flux motors,” *IEEE Transactions on Industry Applications*, vol. 48, no. 2, pp. 612–622, 2012.

- [8] F. Caricchi, F. Crescimbeni, and O. Honorati, “Low-cost compact permanent magnet machine for adjustable-speed pump application,” *IEEE Transactions on Industry applications*, vol. 34, no. 1, pp. 109–116, 1998.
- [9] D.-K. Hong, B.-C. Woo, D.-H. Koo, and U.-J. Seo, “A single-phase brushless dc motor with improved high efficiency for water cooling pump systems,” *IEEE Transactions on Magnetics*, vol. 47, no. 10, pp. 4250–4253, 2011.
- [10] W. V. Jones, “Motor selection made easy: Choosing the right motor for centrifugal pump applications,” *IEEE Industry Applications Magazine*, vol. 19, no. 6, pp. 36–45, 2013.
- [11] G.-H. Jang, J.-H. Ahn, B.-O. Kim, D.-H. Lee, J.-S. Bang, and J.-Y. Choi, “Design and characteristic analysis of a high-speed permanent magnet synchronous motor considering the mechanical structure for high-speed and high-head centrifugal pumps,” *IEEE Transactions on Magnetics*, no. 99, pp. 1–6, 2018.
- [12] M. Z. Youssef, “Design and performance of a cost-effective bldc drive for water pump application,” *IEEE Transactions on Industrial Electronics*, vol. 62, no. 5, pp. 3277–3284, 2015.
- [13] S. Sashidhar and B. Fernandes, “A novel ferrite smds spoke-type bldc motor for pv bore-well submersible water pumps,” *IEEE Transactions on Industrial Electronics*, vol. 64, no. 1, pp. 104–114, 2017.
- [14] C.-S. Jin, D.-S. Jung, K.-C. Kim, Y.-D. Chun, H.-W. Lee, and J. Lee, “A study on improvement magnetic torque characteristics of ipmsm for direct drive washing machine,” *IEEE Transactions on Magnetics*, vol. 45, no. 6, pp. 2811–2814, 2009.
- [15] O. Payza, Y. Demir, and M. Aydin, “Investigation of losses for a concentrated winding high-speed permanent magnet-assisted synchronous reluctance motor for washing machine application,” *IEEE Transactions on Magnetics*, 2018.
- [16] S. Chi, Z. Zhang, and L. Xu, “Sliding-mode sensorless control of direct-drive pm synchronous motors for washing machine applications,” *IEEE Transactions on Industry Applications*, vol. 45, no. 2, pp. 582–590, 2009.

- [17] K.-J. Ko, S.-M. Jang, J.-H. Park, H.-W. Cho, and D.-J. You, "Electromagnetic performance analysis of wind power generator with outer permanent magnet rotor based on turbine characteristics variation over nominal wind speed," *IEEE Transactions on Magnetics*, vol. 47, no. 10, pp. 3292–3295, 2011.
- [18] B. Chalmers and E. Spooner, "An axial-flux permanent-magnet generator for a gearless wind energy system," *IEEE Transactions on Energy conversion*, vol. 14, no. 2, pp. 251–257, 1999.
- [19] L. Jian, K. Chau, and J. Jiang, "A magnetic-geared outer-rotor permanent-magnet brushless machine for wind power generation," *IEEE Transactions on Industry Applications*, vol. 45, no. 3, pp. 954–962, 2009.
- [20] J. Bumby and R. Martin, "Axial-flux permanent-magnet air-cored generator for small-scale wind turbines," *IEE Proceedings-Electric Power Applications*, vol. 152, no. 5, pp. 1065–1075, 2005.
- [21] L. Soderlund, A. Koski, H. Vihriala, J.-T. Eriksson, and R. Perala, "Design of an axial flux permanent magnet wind power generator," 1997.
- [22] M. R. J. Dubois, "Optimized permanent magnet generator topologies for direct-drive wind turbines," Ph.D. dissertation, TU Delft, Delft University of Technology, 2004.
- [23] S. M. Dehghan, M. Mohamadian, and A. Y. Varjani, "A new variable-speed wind energy conversion system using permanent-magnet synchronous generator and z -source inverter," *IEEE Transactions on Energy Conversion*, vol. 24, no. 3, pp. 714–724, 2009.
- [24] A. D. Hansen and G. Michalke, "Multi-pole permanent magnet synchronous generator wind turbines' grid support capability in uninterrupted operation during grid faults," *IET Renewable Power Generation*, vol. 3, no. 3, pp. 333–348, 2009.
- [25] T. Chan and L. Lai, "An axial-flux permanent-magnet synchronous generator for a direct-coupled wind-turbine system," *IEEE Transactions on Energy Conversion*, vol. 22, no. 1, pp. 86–94, 2007.

- [26] A. D. Hansen and G. Michalke, “Modelling and control of variable-speed multi-pole permanent magnet synchronous generator wind turbine,” *Wind Energy*, vol. 11, no. 5, pp. 537–554, 2008.
- [27] E. Spooner and A. Williamson, “Direct coupled, permanent magnet generators for wind turbine applications,” *IEE Proceedings-Electric Power Applications*, vol. 143, no. 1, pp. 1–8, 1996.
- [28] J. Conroy and R. Watson, “Low-voltage ride-through of a full converter wind turbine with permanent magnet generator,” *IET Renewable power generation*, vol. 1, no. 3, pp. 182–189, 2007.
- [29] A. Rolan, A. Luna, G. Vazquez, D. Aguilar, and G. Azevedo, “Modeling of a variable speed wind turbine with a permanent magnet synchronous generator,” in *Industrial Electronics, 2009. ISIE 2009. IEEE International Symposium on*. IEEE, 2009, pp. 734–739.
- [30] C. C. Chan, “The state of the art of electric, hybrid, and fuel cell vehicles,” *Proceedings of the IEEE*, vol. 95, no. 4, pp. 704–718, 2007.
- [31] M. Zeraoulia, M. E. H. Benbouzid, and D. Diallo, “Electric motor drive selection issues for hev propulsion systems: A comparative study,” *IEEE Transactions on Vehicular technology*, vol. 55, no. 6, pp. 1756–1764, 2006.
- [32] A. Emadi, Y. J. Lee, and K. Rajashekara, “Power electronics and motor drives in electric, hybrid electric, and plug-in hybrid electric vehicles,” *IEEE Transactions on industrial electronics*, vol. 55, no. 6, pp. 2237–2245, 2008.
- [33] M. Ehsani, Y. Gao, and J. M. Miller, “Hybrid electric vehicles: Architecture and motor drives,” *Proceedings of the IEEE*, vol. 95, no. 4, pp. 719–728, 2007.
- [34] K. Chau, C. C. Chan, and C. Liu, “Overview of permanent-magnet brushless drives for electric and hybrid electric vehicles,” *IEEE Transactions on industrial electronics*, vol. 55, no. 6, pp. 2246–2257, 2008.
- [35] K. M. Rahman, N. R. Patel, T. G. Ward, J. M. Nagashima, F. Caricchi, and F. Crescimbeni, “Application of direct-drive wheel motor for fuel cell electric and

- hybrid electric vehicle propulsion system,” *IEEE Transactions on Industry Applications*, vol. 42, no. 5, pp. 1185–1192, 2006.
- [36] K. Chau, D. Zhang, J. Jiang, C. Liu, and Y. Zhang, “Design of a magnetic-g geared outer-rotor permanent-magnet brushless motor for electric vehicles,” *IEEE Transactions on Magnetics*, vol. 43, no. 6, pp. 2504–2506, 2007.
- [37] C. C. Chan, K. Chau, J. Jiang, W. Xia, M. Zhu, and R. Zhang, “Novel permanent magnet motor drives for electric vehicles,” *IEEE Transactions on Industrial Electronics*, vol. 43, no. 2, pp. 331–339, 1996.
- [38] X. Xue, K. Cheng, and N. Cheung, “Selection of electric motor drives for electric vehicles,” in *Power Engineering Conference, 2008. AUPEC’08. Australasian Universities*. IEEE, 2008, pp. 1–6.
- [39] F. Caricchi, F. Crescimbeni, E. Fedeli, and G. Noia, “Design and construction of a wheel-directly-coupled axial-flux pm motor prototype for evs,” in *Industry Applications Society Annual Meeting, 1994., Conference Record of the 1994 IEEE*, vol. 2. IEEE, 1994, pp. 254–261.
- [40] K. Rajashekara, “Present status and future trends in electric vehicle propulsion technologies,” *IEEE Journal of Emerging and Selected Topics in Power Electronics*, vol. 1, no. 1, pp. 3–10, 2013.
- [41] Z.-Q. Zhu and D. Howe, “Electrical machines and drives for electric, hybrid, and fuel cell vehicles,” *Proceedings of the IEEE*, vol. 95, no. 4, pp. 746–765, 2007.
- [42] C. Chan, J. Jiang, G. Chen, X. Wang, and K. Chau, “A novel polyphase multipole square-wave permanent magnet motor drive for electric vehicles,” *IEEE Transactions on Industry Applications*, vol. 30, no. 5, pp. 1258–1266, 1994.
- [43] G. Pellegrino, A. Vagati, P. Guglielmi, and B. Boazzo, “Performance comparison between surface-mounted and interior pm motor drives for electric vehicle application,” *IEEE Transactions on Industrial Electronics*, vol. 59, no. 2, pp. 803–811, 2012.

- [44] J. Wang, X. Yuan, and K. Atallah, "Design optimization of a surface-mounted permanent-magnet motor with concentrated windings for electric vehicle applications," *IEEE Transactions on Vehicular Technology*, vol. 62, no. 3, pp. 1053–1064, 2013.
- [45] S. Evans, I. Smith, and J. Kettleborough, "Permanent-magnet linear actuator for static and reciprocating short-stroke electromechanical systems," *IEEE/ASME transactions on mechatronics*, vol. 6, no. 1, pp. 36–42, 2001.
- [46] I. Boldea and S. A. Nasar, "Linear electric actuators and generators," in *Electric Machines and Drives Conference Record, 1997. IEEE International*. IEEE, 1997, pp. MA1–1.
- [47] D. L. Trumper, W.-j. Kim, and M. E. Williams, "Design and analysis framework for linear permanent-magnet machines," *IEEE Transactions on Industry Applications*, vol. 32, no. 2, pp. 371–379, 1996.
- [48] J. Wang, G. W. Jewell, and D. Howe, "A general framework for the analysis and design of tubular linear permanent magnet machines," *IEEE Transactions on Magnetics*, vol. 35, no. 3, pp. 1986–2000, 1999.
- [49] W. Cao, B. C. Mecrow, G. J. Atkinson, J. W. Bennett, and D. J. Atkinson, "Overview of electric motor technologies used for more electric aircraft (mea)." *IEEE transactions on industrial electronics*, vol. 59, no. 9, pp. 3523–3531, 2012.
- [50] B. C. Mecrow, A. G. Jack, D. J. Atkinson, S. R. Green, G. J. Atkinson, A. King, and B. Green, "Design and testing of a four-phase fault-tolerant permanent-magnet machine for an engine fuel pump," *IEEE Transactions on Energy Conversion*, vol. 19, no. 4, pp. 671–678, 2004.
- [51] M. Villani, M. Tursini, G. Fabri, and L. Castellini, "High reliability permanent magnet brushless motor drive for aircraft application," *IEEE transactions on industrial electronics*, vol. 59, no. 5, pp. 2073–2081, 2012.
- [52] J. Wolmarans, H. Polinder, J. A. Ferreira, and D. Clarenbach, "Design of a fault tolerant permanent magnet machine for airplanes," in *Electrical Machines and Systems, 2008. ICEMS 2008. International Conference on*. IEEE, 2008, pp. 2882–2887.

- [53] B. Mecrow, A. Jack, J. Haylock, and J. Coles, "Fault-tolerant permanent magnet machine drives," *IEE Proceedings-Electric Power Applications*, vol. 143, no. 6, pp. 437–442, 1996.
- [54] A. Al-Timimy, P. Giangrande, M. Degano, Z. Xu, M. Galea, C. Gerada, G. L. Calzo, H. Zhang, and L. Xia, "Design and losses analysis of a high power density machine for flooded pump applications," *IEEE Transactions on Industry Applications*, 2018.
- [55] G. J. Atkinson, B. C. Mecrow, A. G. Jack, D. J. Atkinson, P. Sangha, and M. Benarous, "The analysis of losses in high-power fault-tolerant machines for aerospace applications," *IEEE Transactions on Industry Applications*, vol. 42, no. 5, pp. 1162–1170, 2006.
- [56] A. M. El-Refaie, "Fractional-slot concentrated-windings synchronous permanent magnet machines: Opportunities and challenges," *IEEE Transactions on industrial Electronics*, vol. 57, no. 1, pp. 107–121, 2010.
- [57] L. Alberti and N. Bianchi, "Theory and design of fractional-slot multilayer windings," *IEEE Transactions on Industry Applications*, vol. 49, no. 2, pp. 841–849, 2013.
- [58] A. Sun, J. Li, R. Qu, and D. Li, "Effect of multilayer windings on rotor losses of interior permanent magnet generator with fractional-slot concentrated-windings," *IEEE Transactions on Magnetics*, vol. 50, no. 11, pp. 1–4, 2014.
- [59] P. B. Reddy, A. M. El-Refaie, and K.-K. Huh, "Effect of number of layers on performance of fractional-slot concentrated-windings interior permanent magnet machines," *IEEE Transactions on Power Electronics*, vol. 30, no. 4, pp. 2205–2218, 2015.
- [60] Z. Zhu and D. Howe, "Influence of design parameters on cogging torque in permanent magnet machines," *IEEE Transactions on energy conversion*, vol. 15, no. 4, pp. 407–412, 2000.
- [61] A. Mitcham, G. Antonopoulos, and J. Cullen, "Favourable slot and pole number combinations for fault-tolerant pm machines," *IEE Proceedings-Electric Power Applications*, vol. 151, no. 5, pp. 520–525, 2004.

- [62] C. Hwang, M. Wu, and S. Cheng, “Influence of pole and slot combinations on cogging torque in fractional slot pm motors,” *Journal of magnetism and magnetic materials*, vol. 304, no. 1, pp. e430–e432, 2006.
- [63] S.-H. Han, T. M. Jahns, W. L. Soong, M. K. Güven, and M. S. Illindala, “Torque ripple reduction in interior permanent magnet synchronous machines using stators with odd number of slots per pole pair,” *IEEE Transactions on Energy Conversion*, vol. 25, no. 1, pp. 118–127, 2010.
- [64] M.-F. Hsieh and Y.-S. Hsu, “An investigation on influence of magnet arc shaping upon back electromotive force waveforms for design of permanent-magnet brushless motors,” *IEEE Transactions on Magnetics*, vol. 41, no. 10, pp. 3949–3951, 2005.
- [65] M. S. Islam, S. Mir, and T. Sebastian, “Issues in reducing the cogging torque of mass-produced permanent-magnet brushless dc motor,” *IEEE Transactions on Industry Applications*, vol. 40, no. 3, pp. 813–820, 2004.
- [66] A. J. Sorgdrager and A. J. Grobler, “Influence of magnet size and rotor topology on the air-gap flux density of a radial flux pmsm,” in *Industrial Technology (ICIT), 2013 IEEE International Conference on*. IEEE, 2013, pp. 337–343.
- [67] A. Pramanik, *Electromagnetism Volume I (Theory)*. PHI Learning Pvt. Ltd., 2014.
- [68] P. P. Silvester and R. L. Ferrari, *Finite elements for electrical engineers*. Cambridge university press, 1996.
- [69] A. Pramanik, *Electromagnetism Volume II (Applications)*. PHI Learning Pvt. Ltd., 2014.
- [70] D. C. Hanselman, *Brushless permanent magnet motor design*. The Writers’ Collective, 2003.
- [71] J. R. Hendershot and T. J. E. Miller, *Design of brushless permanent-magnet machines*. Motor Design Books, 2010.
- [72] T. Miller, *Permanent Magnet and Reluctance Motor Drives*. Oxford, UK: Oxford Science Publications, 1989.

- [73] V. Honsinger, “The fields and parameters of interior type ac permanent magnet machines,” *IEEE Transactions on Power Apparatus and Systems*, no. 4, pp. 867–876, 1982.
- [74] P. Zhou, M. A. Rahman, and M. Jabbar, “Field circuit analysis of permanent magnet synchronous motors,” *IEEE Transactions on Magnetics*, vol. 30, no. 4, pp. 1350–1359, 1994.
- [75] W.-B. Tsai and T.-Y. Chang, “Analysis of flux leakage in a brushless permanent-magnet motor with embedded magnets,” *IEEE Transactions on Magnetics*, vol. 35, no. 1, pp. 543–547, 1999.
- [76] R. Qu and T. A. Lipo, “Analysis and modeling of air-gap and zigzag leakage fluxes in a surface-mounted permanent-magnet machine,” *IEEE Transactions on Industry Applications*, vol. 40, no. 1, pp. 121–127, 2004.
- [77] V. Ostovic, *Dynamics of saturated electric machines*. Springer Science & Business Media, 2012.
- [78] B. Hague, *Electromagnetic problems in electrical engineering*. Oxford University Press, 1929.
- [79] —, *The Principles of Electromagnetism Applied to Electrical Machines:(formerly Titled: Electromagnetic Problems in Electrical Engineering)*. Dover Publications, 1962.
- [80] A. Hughes and T. Miller, “Analysis of fields and inductances in air-cored and iron-cored synchronous machines,” in *Proceedings of the institution of electrical engineers*, vol. 124, no. 2. IET, 1977, pp. 121–126.
- [81] N. Boules, “Two-dimensional field analysis of cylindrical machines with permanent magnet excitation,” *IEEE Transactions on Industry Applications*, no. 5, pp. 1267–1277, 1984.
- [82] —, “Prediction of no-load flux density distribution in permanent magnet machines,” *IEEE Transactions on Industry Applications*, no. 3, pp. 633–643, 1985.

- [83] —, “Design optimization of permanent magnet dc motors,” *IEEE Transactions on Industry Applications*, vol. 26, no. 4, pp. 786–792, 1990.
- [84] J. R. Bumby, R. Martin, M. Mueller, E. Spooner, N. Brown, and B. Chalmers, “Electromagnetic design of axial-flux permanent magnet machines,” *IEE Proceedings-Electric Power Applications*, vol. 151, no. 2, pp. 151–160, 2004.
- [85] S. Nasar and G. Xiong, “Determination of the field of a permanent-magnet disk machine using the concept of magnetic charge,” *IEEE Transactions on Magnetics*, vol. 24, no. 3, pp. 2038–2044, 1988.
- [86] G. Xiong and S. Nasar, “Analysis of fields and forces in a permanent magnet linear synchronous machine based on the concept of magnetic charge,” *IEEE Transactions on magnetics*, vol. 25, no. 3, pp. 2713–2719, 1989.
- [87] Z. Zhu, D. Howe, E. Bolte, and B. Ackermann, “Instantaneous magnetic field distribution in brushless permanent magnet dc motors. i. open-circuit field,” *IEEE transactions on magnetics*, vol. 29, no. 1, pp. 124–135, 1993.
- [88] Z. Zhu and D. Howe, “Instantaneous magnetic field distribution in brushless permanent magnet dc motors. ii. armature-reaction field,” *IEEE Transactions on Magnetics*, vol. 29, no. 1, pp. 136–142, 1993.
- [89] —, “Instantaneous magnetic field distribution in brushless permanent magnet dc motors. iii. effect of stator slotting,” *IEEE transactions on magnetics*, vol. 29, no. 1, pp. 143–151, 1993.
- [90] —, “Instantaneous magnetic field distribution in permanent magnet brushless dc motors. iv. magnetic field on load,” *IEEE Transactions on Magnetics*, vol. 29, no. 1, pp. 152–158, 1993.
- [91] —, “Analytical prediction of the cogging torque in radial-field permanent magnet brushless motors,” *IEEE transactions on magnetics*, vol. 28, no. 2, pp. 1371–1374, 1992.
- [92] U. Kim and D. K. Lieu, “Magnetic field calculation in permanent magnet motors with rotor eccentricity: without slotting effect,” *IEEE Transactions on Magnetics*, vol. 34, no. 4, pp. 2243–2252, 1998.

- [93] —, “Magnetic field calculation in permanent magnet motors with rotor eccentricity: With slotting effect considered,” *IEEE Transactions on Magnetics*, vol. 34, no. 4, pp. 2253–2266, 1998.
- [94] —, “Effects of magnetically induced vibration force in brushless permanent-magnet motors,” *IEEE Transactions on Magnetics*, vol. 41, no. 6, pp. 2164–2172, 2005.
- [95] A. Rahideh and T. Korakianitis, “Analytical open-circuit magnetic field distribution of slotless brushless permanent-magnet machines with rotor eccentricity,” *IEEE Transactions on Magnetics*, vol. 47, no. 12, pp. 4791–4808, 2011.
- [96] K. F. Rasmussen, “Analytical prediction of magnetic field from surface mounted permanent magnet motor,” in *Electric Machines and Drives, 1999. International Conference IEMD’99*. IEEE, 1999, pp. 34–36.
- [97] Z. Zhu, D. Howe, and C. Chan, “Improved analytical model for predicting the magnetic field distribution in brushless permanent-magnet machines,” *IEEE Transactions on Magnetics*, vol. 38, no. 1, pp. 229–238, 2002.
- [98] Z. Xia, Z. Zhu, and D. Howe, “Analytical magnetic field analysis of halbach magnetized permanent-magnet machines,” *IEEE Transactions on Magnetics*, vol. 40, no. 4, pp. 1864–1872, 2004.
- [99] Z. Zhu and D. Howe, “Halbach permanent magnet machines and applications: a review,” *IEE Proceedings-Electric Power Applications*, vol. 148, no. 4, pp. 299–308, 2001.
- [100] A. Rahideh and T. Korakianitis, “Analytical magnetic field distribution of slotless brushless permanent magnet motors—part 1. armature reaction field, inductance and rotor eddy current loss calculations,” *IET Electric Power Applications*, vol. 6, no. 9, pp. 628–638, 2012.
- [101] —, “Analytical magnetic field distribution of slotless brushless pm motors. part 2: Open-circuit field and torque calculations,” *IET Electric Power Applications*, vol. 6, no. 9, pp. 639–651, 2012.

- [102] Z. Zhu, D. Howe, and Z. Xia, “Prediction of open-circuit airgap field distribution in brushless machines having an inset permanent magnet rotor topology,” *IEEE transactions on magnetics*, vol. 30, no. 1, pp. 98–107, 1994.
- [103] A. Rahideh and T. Korakianitis, “Analytical magnetic field distribution of slotless brushless machines with inset permanent magnets,” *IEEE Transactions on Magnetism*, vol. 47, no. 6, p. 1763, 2011.
- [104] —, “Analytical armature reaction field distribution of slotless brushless machines with inset permanent magnets,” *IEEE Transactions on Magnetism*, vol. 48, no. 7, pp. 2178–2191, 2012.
- [105] A. Rahideh, M. Mardaneh, and T. Korakianitis, “Analytical 2-d calculations of torque, inductance, and back-emf for brushless slotless machines with surface inset magnets,” *IEEE Transactions on Magnetism*, vol. 49, no. 8, pp. 4873–4884, 2013.
- [106] D. Zarko, D. Ban, and T. A. Lipo, “Analytical calculation of magnetic field distribution in the slotted air gap of a surface permanent-magnet motor using complex relative air-gap permeance,” *IEEE Transactions on Magnetism*, vol. 42, no. 7, pp. 1828–1837, 2006.
- [107] —, “Analytical solution for cogging torque in surface permanent-magnet motors using conformal mapping,” *IEEE Transactions on Magnetism*, vol. 44, no. 1, pp. 52–65, 2008.
- [108] —, “Analytical solution for electromagnetic torque in surface permanent-magnet motors using conformal mapping,” *IEEE transactions on magnetics*, vol. 45, no. 7, pp. 2943–2954, 2009.
- [109] K. Boughrara, R. Ibtouen, O. Touhami, and D. Zarko, “Analytical and numerical calculation of magnetic field distribution in the slotted air-gap of tangential surface permanent-magnet motors,” *Serbian Journal of Electrical Engineering*, vol. 6, no. 1, pp. 15–31, 2009.
- [110] K. Boughrara, B. L. Chikouche, R. Ibtouen, D. Zarko, and O. Touhami, “Analytical model of slotted air-gap surface mounted permanent-magnet synchronous

motor with magnet bars magnetized in the shifting direction,” *IEEE Transactions on Magnetics*, vol. 45, no. 2, pp. 747–758, 2009.

- [111] K. Boughrara, R. Ibtouen, D. Zarko, O. Touhami, and A. Rezzoug, “Magnetic field analysis of external rotor permanent-magnet synchronous motors using conformal mapping,” *IEEE transactions on magnetics*, vol. 46, no. 9, pp. 3684–3693, 2010.
- [112] L. Liu and S. Yang, “A numerical conformal transformation for investigating slot effects of high speed brushless pm motors,” in *Automation Congress, 2008. WAC 2008. World.* IEEE, 2008, pp. 1–4.
- [113] K. Boughrara, R. Ibtouen, and T. Lubin, “Analytical prediction of magnetic field in parallel double excitation and spoke-type permanent-magnet machines accounting for tooth-tips and shape of polar pieces,” *IEEE Transactions on Magnetics*, vol. 48, no. 7, pp. 2121–2137, 2012.
- [114] G. Qishan and G. Hongzhan, “The fringing effect in pm electric machines,” *Electric machines and power systems*, vol. 11, no. 2, pp. 159–169, 1986.
- [115] H. Ittstein, “Analytical calculation of the cogging torques of a two-pole permanent-magnet-excited dc motor,” *Electrical Engineering (Archive for Electrical Engineering)*, vol. 75, no. 4, pp. 283–292, 1992.
- [116] B. Ackermann and R. Sottek, “Analytical modeling of the cogging torque in permanent magnet motors,” *Electrical Engineering (Archiv fur Elektrotechnik)*, vol. 78, no. 2, pp. 117–125, 1995.
- [117] Z. Liu and J. Li, “Analytical solution of air-gap field in permanent-magnet motors taking into account the effect of pole transition over slots,” *IEEE Transactions on Magnetics*, vol. 43, no. 10, pp. 3872–3883, 2007.
- [118] —, “Accurate prediction of magnetic field and magnetic forces in permanent magnet motors using an analytical solution,” *IEEE Transactions on Energy Conversion*, vol. 23, no. 3, pp. 717–726, 2008.
- [119] Z. Liu, J. Li, and Q. Jiang, “An improved analytical solution for predicting magnetic forces in permanent magnet motors,” *Journal of Applied Physics*, vol. 103, no. 7, p. 07F135, 2008.

- [120] F. Dubas and C. Espanet, “Analytical solution of the magnetic field in permanent-magnet motors taking into account slotting effect: No-load vector potential and flux density calculation,” *IEEE Transactions on Magnetics*, vol. 45, no. 5, p. 2097, 2009.
- [121] Z. Zhu, L. Wu, and Z. Xia, “An accurate subdomain model for magnetic field computation in slotted surface-mounted permanent-magnet machines,” *IEEE Transactions on Magnetics*, vol. 46, no. 4, pp. 1100–1115, 2010.
- [122] T. Lubin, S. Mezani, and A. Rezzoug, “2-d exact analytical model for surface-mounted permanent-magnet motors with semi-closed slots,” *IEEE Transactions on Magnetics*, vol. 47, no. 2, p. 479, 2011.
- [123] L. Wu, Z. Zhu, D. Staton, M. Popescu, and D. Hawkins, “An improved subdomain model for predicting magnetic field of surface-mounted permanent magnet machines accounting for tooth-tips,” *IEEE Transactions on Magnetics*, vol. 47, no. 6, pp. 1693–1704, 2011.
- [124] —, “Subdomain model for predicting armature reaction field of surface-mounted permanent-magnet machines accounting for tooth-tips,” *IEEE Transactions on Magnetics*, vol. 47, no. 4, pp. 812–822, 2011.
- [125] —, “Analytical prediction of electromagnetic performance of surface-mounted pm machines based on subdomain model accounting for tooth-tips,” *IET Electric Power Applications*, vol. 5, no. 7, pp. 597–609, 2011.
- [126] T. L. Tiang, D. Ishak, C. P. Lim, and M. K. M. Jamil, “A comprehensive analytical subdomain model and its field solutions for surface-mounted permanent magnet machines,” *IEEE Transactions on Magnetics*, vol. 51, no. 4, pp. 1–14, 2015.
- [127] T. Lubin, S. Mezani, and A. Rezzoug, “Two-dimensional analytical calculation of magnetic field and electromagnetic torque for surface-inset permanent-magnet motors,” *IEEE Transactions on Magnetics*, vol. 48, no. 6, pp. 2080–2091, 2012.
- [128] A. Rahideh and T. Korakianitis, “Analytical magnetic field calculation of slotted brushless permanent-magnet machines with surface inset magnets,” *IEEE transactions on magnetics*, vol. 48, no. 10, pp. 2633–2649, 2012.

- [129] S. Teymoori, A. Rahideh, H. Moayed-Jahromi, and M. Mardaneh, “2-d analytical magnetic field prediction for consequent-pole permanent magnet synchronous machines,” *IEEE Transactions on Magnetics*, vol. 52, no. 6, pp. 1–14, 2016.
- [130] J. Fu and C. Zhu, “Subdomain model for predicting magnetic field in slotted surface mounted permanent-magnet machines with rotor eccentricity,” *IEEE Transactions on Magnetics*, vol. 48, no. 5, pp. 1906–1917, 2012.
- [131] H. Qian, H. Guo, Z. Wu, and X. Ding, “Analytical solution for cogging torque in surface-mounted permanent-magnet motors with magnet imperfections and rotor eccentricity,” *IEEE Transactions on Magnetics*, vol. 50, no. 8, pp. 1–15, 2014.
- [132] Z. Zhu, L. Wu, and M. M. Jamil, “Influence of pole and slot number combinations on cogging torque in permanent-magnet machines with static and rotating eccentricities,” *IEEE Transactions on Industry Applications*, vol. 50, no. 5, pp. 3265–3277, 2014.
- [133] V. Honsinger, “Sizing equations for electrical machinery,” *IEEE transactions on energy conversion*, no. 1, pp. 116–121, 1987.
- [134] S. Huang, J. Luo, F. Leonardi, and T. A. Lipo, “A general approach to sizing and power density equations for comparison of electrical machines,” *IEEE Transactions on Industry Applications*, vol. 34, no. 1, pp. 92–97, 1998.
- [135] P. Kumar and P. Bauer, “Improved analytical model of a permanent-magnet brushless dc motor,” *IEEE Transactions on Magnetics*, vol. 44, no. 10, pp. 2299–2309, 2008.
- [136] A. Dalal and P. Kumar, “Analytical model for permanent magnet motor with slotting effect, armature reaction, and ferromagnetic material property,” *IEEE Transactions on Magnetics*, vol. 51, no. 12, pp. 1–10, 2015.
- [137] R. Sprangers, J. Paulides, B. Gysen, and E. Lomonova, “Magnetic saturation in semi-analytical harmonic modeling for electric machine analysis,” *IEEE Transactions on Magnetics*, vol. 52, no. 2, pp. 1–10, 2016.

- [138] F. Dubas and K. Boughrara, “New scientific contribution on the 2-d subdomain technique in cartesian coordinates: Taking into account of iron parts,” *Mathematical and Computational Applications*, vol. 22, no. 1, p. 17, 2017.
- [139] Z. Djelloul-Khedda, K. Boughrara, F. Dubas, A. Kechroud, and B. Souleyman, “Semi-analytical magnetic field predicting in many structures of permanent-magnet synchronous machines considering the iron permeability,” *IEEE Transactions on Magnetics*, 2018.
- [140] L. Roubache, K. Boughrara, F. Dubas, and R. Ibtiouen, “New subdomain technique for electromagnetic performances calculation in radial-flux electrical machines considering finite soft-magnetic material permeability,” *IEEE Transactions on Magnetics*, 2018.
- [141] Z. Azar, Z. Zhu, and G. Ombach, “Influence of electric loading and magnetic saturation on cogging torque, back-emf and torque ripple of pm machines,” *IEEE Transactions on Magnetics*, vol. 48, no. 10, pp. 2650–2658, 2012.
- [142] W. Chu and Z. Zhu, “On-load cogging torque calculation in permanent magnet machines,” *IEEE transactions on magnetics*, vol. 49, no. 6, pp. 2982–2989, 2013.
- [143] D. Wu and Z. Zhu, “On-load voltage distortion in fractional slot surface-mounted permanent magnet machines considering local magnetic saturation,” *IEEE Transactions on Magnetics*, vol. 51, no. 8, pp. 1–10, 2015.
- [144] W. Chu and Z. Zhu, “Average torque separation in permanent magnet synchronous machines using frozen permeability,” *IEEE Trans. Magn.*, vol. 49, no. 3, pp. 1202–1210, 2013.
- [145] S.-Y. Kwak, J.-K. Kim, and H.-K. Jung, “Characteristic analysis of multilayer-buried magnet synchronous motor using fixed permeability method,” *IEEE Transactions on Energy Conversion*, vol. 20, no. 3, pp. 549–555, 2005.
- [146] M. Ge, J. Li, R. Qu, Y. Lu, and J. Chen, “A synthetic frozen permeability method for torque separation in hybrid pm variable-flux machines,” *IEEE Transactions on Applied Superconductivity*, vol. 28, no. 3, pp. 1–5, 2018.

- [147] J. A. Walker, D. G. Dorrell, and C. Cossar, “Flux-linkage calculation in permanent-magnet motors using the frozen permeabilities method,” *IEEE Transactions on Magnetics*, 2005.
- [148] N. Bianchi and S. Bolognani, “Magnetic models of saturated interior permanent magnet motors based on finite element analysis,” in *Industry Applications Conference, 1998. Thirty-Third IAS Annual Meeting. The 1998 IEEE*, vol. 1. IEEE, 1998, pp. 27–34.
- [149] X. Chen, J. Wang, V. Patel, P. Lazari, L. Chen, and P. Lombard, “Reluctance torque evaluation for interior permanent magnet machines using frozen permeability,” 2014.
- [150] J. K. Tangudu, T. Jahns, A. El-Refaie, and Z. Zhu, “Segregation of torque components in fractional-slot concentrated-winding interior pm machines using frozen permeability,” in *Energy Conversion Congress and Exposition, 2009. ECCE 2009. IEEE*. IEEE, 2009, pp. 3814–3821.
- [151] Y. N. Zhilichev, “Three-dimensional analytic model of permanent magnet axial flux machine,” *IEEE transactions on magnetics*, vol. 34, no. 6, pp. 3897–3901, 1998.
- [152] E. Furlani and M. Knewtson, “A three-dimensional field solution for permanent-magnet axial-field motors,” *IEEE transactions on magnetics*, vol. 33, no. 3, pp. 2322–2325, 1997.
- [153] A. Dwivedi, S. kumar Singh, and R. K. Srivastava, “Analysis and performance evaluation of axial flux permanent magnet motors,” *IEEE Transactions on Industry Applications*, vol. 54, no. 2, pp. 1765–1772, 2018.
- [154] A. Dwivedi, S. K. Singh, and R. K. Srivastava, “Analysis of permanent magnet brushless ac motor using fourier transform approach,” *IET Electric Power Applications*, vol. 10, no. 6, pp. 539–547, 2016.
- [155] P. Virtic, P. Pisek, T. Marcic, M. Hadziselimovic, and B. Stumberger, “Analytical analysis of magnetic field and back electromotive force calculation of an axial-flux permanent magnet synchronous generator with coreless stator,” *IEEE Transactions on Magnetics*, vol. 44, no. 11, pp. 4333–4336, 2008.

- [156] P. Virtic, P. Pisek, M. Hadziselimovic, T. Marcic, and B. Stumberger, "Torque analysis of an axial flux permanent magnet synchronous machine by using analytical magnetic field calculation," *IEEE Transactions on Magnetics*, vol. 45, no. 3, pp. 1036–1039, 2009.
- [157] Y. Huang, B. Ge, J. Dong, H. Lin, J. Zhu, and Y. Guo, "3-d analytical modeling of no-load magnetic field of ironless axial flux permanent magnet machine," *IEEE Transactions on Magnetics*, vol. 48, no. 11, pp. 2929–2932, 2012.
- [158] P. Jin, Y. Yuan, J. Minyi, F. Shuhua, L. Heyun, H. Yang, and S. Ho, "3-d analytical magnetic field analysis of axial flux permanent-magnet machine," *IEEE Transactions on Magnetics*, vol. 50, no. 11, pp. 1–4, 2014.
- [159] P. Jin, Y. Yuan, Q. Xu, S. Fang, H. Lin, and S. Ho, "Analysis of axial-flux halbach permanent-magnet machine," *IEEE transactions on magnetics*, vol. 51, no. 11, pp. 1–4, 2015.
- [160] W. Fei and P. Luk, "Torque ripple reduction of axial flux permanent magnet synchronous machine with segmented and laminated stator," in *Energy Conversion Congress and Exposition, 2009. ECCE 2009. IEEE*. IEEE, 2009, pp. 132–138.
- [161] H.-J. Shin, J.-Y. Choi, H.-W. Cho, and S.-M. Jang, "Analytical torque calculations and experimental testing of permanent magnet axial eddy current brake," *IEEE Transactions on Magnetics*, vol. 49, no. 7, pp. 4152–4155, 2013.
- [162] A. Bellara, Y. Amara, G. Barakat, and P. Reghem, "Analytical modelling of the magnetic field in axial flux permanent magnet machines with semi-closed slots at no load," in *Electrical Machines (ICEM), 2010 XIX International Conference on*. IEEE, 2010, pp. 1–6.
- [163] J. Azzouzi, G. Barakat, and B. Dakyo, "Quasi-3-d analytical modeling of the magnetic field of an axial flux permanent-magnet synchronous machine," *IEEE Transactions on Energy Conversion*, vol. 20, no. 4, pp. 746–752, 2005.
- [164] H. Tieгна, Y. Amara, and G. Barakat, "A new quasi-3-d analytical model of axial flux permanent magnet machines," *IEEE Transactions on Magnetics*, vol. 50, no. 2, pp. 817–820, 2014.

- [165] H. Tiegna, A. Bellara, Y. Amara, and G. Barakat, “Analytical modeling of the open-circuit magnetic field in axial flux permanent-magnet machines with semi-closed slots,” *IEEE Transactions on Magnetics*, vol. 48, no. 3, pp. 1212–1226, 2012.
- [166] S.-M. Hwang, J.-B. Eom, G.-B. Hwang, W.-B. Jeong, and Y.-H. Jung, “Cogging torque and acoustic noise reduction in permanent magnet motors by teeth pairing,” *IEEE Transactions on Magnetics*, vol. 36, no. 5, pp. 3144–3146, 2000.
- [167] S.-M. Hwang, J.-B. Eom, Y.-H. Jung, D.-W. Lee, and B.-S. Kang, “Various design techniques to reduce cogging torque by controlling energy variation in permanent magnet motors,” *IEEE Transactions on Magnetics*, vol. 37, no. 4, pp. 2806–2809, 2001.
- [168] L. Zhu, S. Jiang, Z. Zhu, and C. Chan, “Analytical methods for minimizing cogging torque in permanent-magnet machines,” *IEEE transactions on magnetics*, vol. 45, no. 4, pp. 2023–2031, 2009.
- [169] —, “Comparison of alternate analytical models for predicting cogging torque in surface-mounted permanent magnet machines,” in *Vehicle Power and Propulsion Conference, 2008. VPPC’08. IEEE*. IEEE, 2008, pp. 1–6.
- [170] L. Wu, Z. Zhu, D. A. Staton, M. Popescu, and D. Hawkins, “Comparison of analytical models of cogging torque in surface-mounted pm machines,” *IEEE Transactions on Industrial Electronics*, vol. 59, no. 6, pp. 2414–2425, 2012.
- [171] Z. Chen and E. Spooner, “A modular, permanent-magnet generator for variable speed wind turbines,” 1995.
- [172] E. Spooner and A. Williamson, “Modular, permanent-magnet wind-turbine generators,” in *Industry Applications Conference, 1996. Thirty-First IAS Annual Meeting, IAS’96., Conference Record of the 1996 IEEE*, vol. 1. IEEE, 1996, pp. 497–502.
- [173] E. Spooner, A. Williamson, and G. Catto, “Modular design of permanent-magnet generators for wind turbines,” *IEE Proceedings-Electric Power Applications*, vol. 143, no. 5, pp. 388–395, 1996.

- [174] Z. Zhu and Y. Li, “Modularity techniques in high performance permanent magnet machines and applications,” *CES Transactions on Electrical Machines and Systems*, vol. 2, no. 1, pp. 93–103, 2018.
- [175] M. F. Momen and S. Datta, “Analysis of flux leakage in a segmented core brushless permanent magnet motor,” *IEEE Transactions on energy conversion*, vol. 24, no. 1, pp. 77–81, 2009.
- [176] Z. Zhu, Z. Azar, and G. Ombach, “Influence of additional air gaps between stator segments on cogging torque of permanent-magnet machines having modular stators,” *IEEE Transactions on Magnetics*, vol. 48, no. 6, pp. 2049–2055, 2012.
- [177] T.-Y. Lee, M.-K. Seo, Y.-J. Kim, and S.-Y. Jung, “Cogging torque of surface-mounted permanent magnet synchronous motor according to segmented-stator core effect,” in *Electrical Machines (ICEM), 2016 XXII International Conference on*. IEEE, 2016, pp. 200–206.
- [178] G. Dajaku and D. Gerling, “Low costs and high-efficiency electric machines,” in *Electric Drives Production Conference (EDPC), 2012 2nd International*. IEEE, 2012, pp. 1–7.
- [179] W. Jara, I. Petrov, J. Tapia, P. Lindh, and J. Pyrhönen, “Analytical model of tooth-coil winding permanent magnet synchronous machines with modular u-shape stator,” in *Electrical Machines (ICEM), 2016 XXII International Conference on*. IEEE, 2016, pp. 145–151.
- [180] G. Li, Z. Zhu, W. Chu, M. Foster, and D. Stone, “Influence of flux gaps on electromagnetic performance of novel modular pm machines,” *IEEE Transactions on Energy Conversion*, vol. 29, no. 3, pp. 716–726, 2014.
- [181] G. J. Li, B. Ren, and Z. Q. Zhu, “Design guidelines for fractional slot multi-phase modular permanent magnet machines,” *IET Electric Power Applications*, vol. 11, no. 6, pp. 1023–1031, 2017.
- [182] G. Li, B. Ren, and Z. Zhu, “Cogging torque and torque ripple reduction of modular permanent magnet machines,” in *Electrical Machines (ICEM), 2016 XXII International Conference on*. IEEE, 2016, pp. 193–199.

- [183] G. Li and Z. Zhu, “Analytical modeling of modular and unequal tooth width surface-mounted permanent magnet machines,” *IEEE Transactions on Magnetics*, vol. 51, no. 9, pp. 1–9, 2015.
- [184] G.-J. Li, Z.-Q. Zhu, M. P. Foster, D. A. Stone, and H.-L. Zhan, “Modular permanent-magnet machines with alternate teeth having tooth tips,” *IEEE Transactions on Industrial Electronics*, vol. 62, no. 10, pp. 6120–6130, 2015.
- [185] G. Li, B. Ren, Z. Zhu, Y. Li, and J. Ma, “Cogging torque mitigation of modular permanent magnet machines,” *IEEE Transactions on Magnetics*, vol. 52, no. 1, pp. 1–10, 2016.
- [186] Y. Yao and Q. Lu, “Comparative study of e-core and c-core modular pm linear machines with different slot/pole combinations,” *IEEE Transactions on Magnetics*, vol. 53, no. 11, pp. 1–7, 2017.
- [187] G. J. Li, Z. Q. Zhu, M. Foster, and D. Stone, “Comparative studies of modular and unequal tooth pm machines either with or without tooth tips,” *IEEE Transactions on Magnetics*, vol. 50, no. 7, pp. 1–10, 2014.
- [188] G.-J. Li and Z.-Q. Zhu, “Demagnetization of modular surface mounted permanent magnet machines,” in *Electrical Machines (ICEM), 2016 XXII International Conference on*. IEEE, 2016, pp. 702–708.
- [189] J. Wang, Z. Xia, and D. Howe, “Analysis of three-phase surface-mounted magnet modular permanent magnet machines,” in *Power Electronics, Machines and Drives, 2004.(PEMD 2004). Second International Conference on (Conf. Publ. No. 498)*, vol. 3. IET, 2004, pp. 27–32.
- [190] B. Ren, G. Li, Z. Zhu, M. Foster, and D. Stone, “Performance comparison between consequent-pole and inset modular permanent magnet machines,” in *PEMD 2018*. IET, 2018.
- [191] J. Wanjiku, M. Khan, P. S. Barendse, and P. Pillay, “Influence of slot openings and tooth profile on cogging torque in axial-flux pm machines,” *IEEE Transactions on Industrial Electronics*, vol. 62, no. 12, pp. 7578–7589, 2015.

- [192] Z. Zhu and D. Howe, "Analytical prediction of the cogging torque in radial-field permanent magnet brushless motors," *IEEE transactions on magnetics*, vol. 28, no. 2, pp. 1371–1374, 1992.
- [193] C. Xia, Z. Zhang, and Q. Geng, "Analytical modeling and analysis of surface mounted permanent magnet machines with skewed slots," *IEEE Transactions on Magnetism*, vol. 51, no. 5, pp. 1–8, 2015.
- [194] Z. Zhu and D. Howe, "Influence of design parameters on cogging torque in permanent magnet machines," *IEEE Transactions on energy conversion*, vol. 15, no. 4, pp. 407–412, 2000.
- [195] N. Bianchi and S. Bolognani, "Design techniques for reducing the cogging torque in surface-mounted pm motors," *IEEE Transactions on Industry Applications*, vol. 38, no. 5, pp. 1259–1265, 2002.
- [196] L. Dosiek and P. Pillay, "Cogging torque reduction in permanent magnet machines," *IEEE Transactions on Industry Applications*, vol. 43, no. 6, pp. 1565–1571, 2007.
- [197] Y. Yang, X. Wang, R. Zhang, T. Ding, and R. Tang, "The optimization of pole arc coefficient to reduce cogging torque in surface-mounted permanent magnet motors," *IEEE Transactions on Magnetism*, vol. 42, no. 4, pp. 1135–1138, 2006.
- [198] C. Hwang, S. John, and S. Wu, "Reduction of cogging torque in spindle motors for cd-rom drive," *IEEE transactions on magnetics*, vol. 34, no. 2, pp. 468–470, 1998.
- [199] L. Wu, Z. Zhu, D. Staton, M. Popescu, and D. Hawkins, "An improved subdomain model for predicting magnetic field of surface-mounted permanent magnet machines accounting for tooth-tips," *IEEE Transactions on Magnetism*, vol. 47, no. 6, pp. 1693–1704, 2011.
- [200] L. Wu, Z. Zhu, D. A. Staton, M. Popescu, and D. Hawkins, "Comparison of analytical models of cogging torque in surface-mounted pm machines," *IEEE Transactions on Industrial Electronics*, vol. 59, no. 6, pp. 2414–2425, 2012.
- [201] S. T. Boroujeni and V. Zamani, "A novel analytical model for no-load, slotted, surface-mounted pm machines: air gap flux density and cogging torque," *IEEE Transactions on Magnetism*, vol. 51, no. 4, pp. 1–8, 2015.

- [202] Z. Zhu, S. Ruangsinchaiwanich, Y. Chen, and D. Howe, "Evaluation of superposition technique for calculating cogging torque in permanent-magnet brushless machines," *IEEE Transactions on Magnetics*, vol. 42, no. 5, pp. 1597–1603, 2006.
- [203] Z. Zhu, S. Ruangsinchaiwanich, and D. Howe, "Synthesis of cogging-torque waveform from analysis of a single stator slot," *IEEE Transactions on Industry Applications*, vol. 42, no. 3, pp. 650–657, 2006.
- [204] L. Wu, Z. Zhu, D. Staton, M. Popescu, and D. Hawkins, "Analytical cogging torque prediction for surface-mounted pm machines accounting for different slot sizes and uneven positions," in *Electric Machines & Drives Conference (IEMDC), 2011 IEEE International*. IEEE, 2011, pp. 1322–1327.
- [205] D. Wang, X. Wang, D. Qiao, Y. Pei, and S.-Y. Jung, "Reducing cogging torque in surface-mounted permanent-magnet motors by nonuniformly distributed teeth method," *IEEE Transactions on Magnetics*, vol. 47, no. 9, pp. 2231–2239, 2011.
- [206] M. Aydin, Z. Zhu, T. Lipo, and D. Howe, "Minimization of cogging torque in axial-flux permanent-magnet machines: Design concepts," *IEEE Transactions on Magnetics*, vol. 43, no. 9, pp. 3614–3622, 2007.