

(51) International Patent Classification:
H02P 21/00 (2006.01)[US/US]; 825 Arcadia Avenue #12, Arcadia, California
91007-7226 (US).(21) International Application Number:
PCT/US2009/058119(74) Agents: **CANNING, Anthony J.** et al.; Nixon Peabody
LLP, 200 Page Mill Road, 2nd Floor, Palo Alto, California
94306-2022 (US).(22) International Filing Date:
23 September 2009 (23.09.2009)(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ,
CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO,
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP,
KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD,
ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI,
NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD,
SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT,
TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(25) Filing Language: English

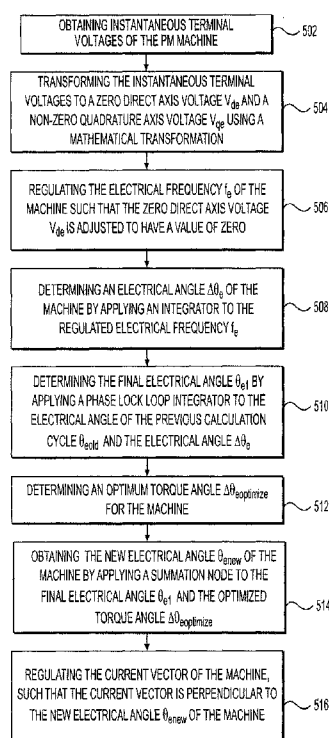
(26) Publication Language: English

(30) Priority Data:
61/194,030 23 September 2008 (23.09.2008) US(71) Applicant (for all designated States except US):
AEROVIRONMENT, INC. [US/US]; 181 W. Hunting-
ton Drive, Suite 202, Monrovia, California 91016 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **BERMAN, Scott**
Garret [US/US]; 850 S. Shenandoah #12, Los Angeles,
California 90035 (US). **DABOUSSI, Zaher Abdallah**(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,
ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ,

[Continued on next page]

(54) Title: SENSORLESS OPTIMUM TORQUE CONTROL FOR HIGH EFFICIENCY IRONLESS PERMANENT MAGNET
MACHINE**FIG. 5**

(57) Abstract: Embodiments of the present invention permit the optimization of torque control of a permanent magnet machine including obtaining instantaneous terminal voltages of the machine, transforming the instantaneous terminal voltages to a zero direct axis voltage and a non-zero quadrature axis voltage, using a mathematical transformation, regulating the electrical frequency of the permanent-magnet machine such that the zero direct-axis voltage is adjusted to have a value of zero, determining a non-final electrical angle of the permanent-magnet machine by applying an integrator to the regulated electrical frequency of the machine, determining a final electrical angle of the machine by integrating the non-final electrical angle and an electrical angle from a previous calculation cycle, and regulating the current vector of the machine such that the current vector is perpendicular to the final electrical angle of the machine, thereby optimizing the torque of the machine.



TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, **Published:**

ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,

MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM,

TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,

ML, MR, NE, SN, TD, TG).

— *with international search report (Art. 21(3))*