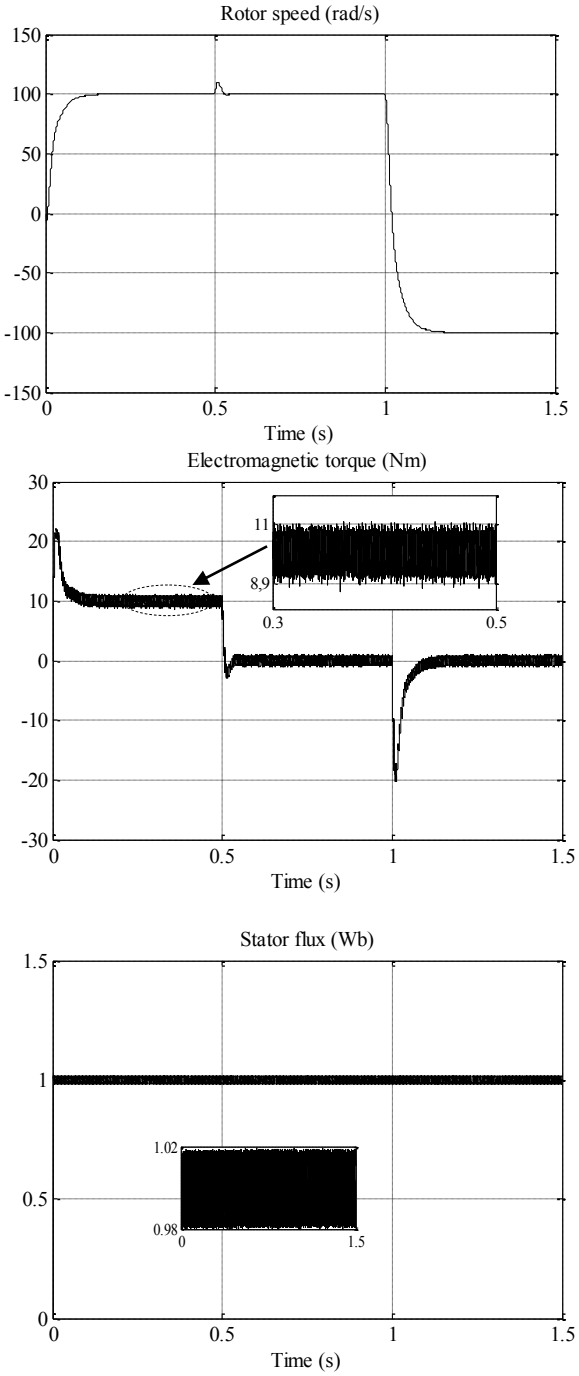

Fig. 7 Dynamic responses of two-level DTC-ANN for DSIM.

Note that the speed follows its reference value while the electromagnetic torque reaches slowly its reference value. Elimination of the load torque causes a slight variation in speed response. The speed controller intervenes to face this variation and ensures that the system follows its suitable reference speed. Moreover, the decoupling control between electromagnetic torque and stator flux is always confirmed. It is important to notice in Fig. 7 that the electromagnetic torque and stator flux ripples are considerably decreased in comparison with Fig. 8.

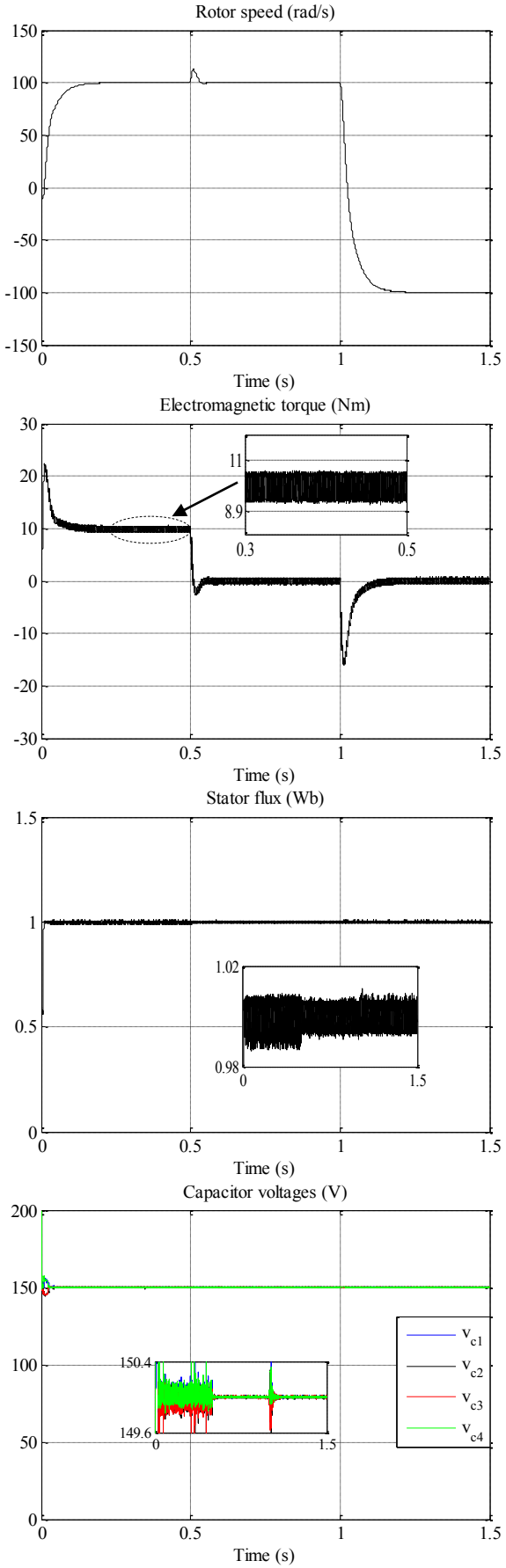

Fig. 8 Dynamic responses of five-level DTC-ANN with balancing strategy for DSIM.

It can be observed also that the proposed balancing strategy is able to guarantee capacitor voltages balance even during the abovementioned transits. In addition, the tracking capability is further improved. Moreover, the decoupling control between torque and stator flux is always confirmed.

VIII. CONCLUSION

In this paper, a five-level DTC-ANN method applied on DSIM is presented and its merits over the conventional DTC approach are confirmed by simulation results. One important problem with the five-level DCI topology is the problem of voltage imbalance in DC capacitors. The multilevel diode-clamped inverter has an inherent problem of DC-link capacitors voltages fluctuations. This problem can be solved in satisfactory way by using a simplified multilevel DTC-ANN algorithm equipped by a balancing strategy. This solution has offered the opportunity to equalize the different input DC voltages of the inverter and improve the performances of the multiphase machine.

APPENDIX

The parameters of DSIM are given in Table 5.

Quantity	Symbols	Value
Stator resistance	R_s	4.67 Ω
Rotor resistance	R_r	8 Ω
Stator inductance	L_s	0.374 H
Rotor inductance	L_r	0.374 H
Mutual inductance	M	0.365 H
Inertia moment	J	0.003 kgm^2
Pair of poles	p	1
Rated speed	Ω_n	2830 *rpm*
Rated voltage	v_n	220 V
Rated power	P_n	1 kW

Table 5. DSIM parameters.

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