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Sensorless PMBLDC Motor Driven Solar-PV Battery Fed EV System with Regenerative Braking Employing Zeta Converter : A Review

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Abstract: *This review surveys recent research on sensorless permanent-magnet brushless DC (PMBLDC / PMBLDCM) motor drives for electric vehicles (EVs) powered by solar-PV + battery sources, with specific attention to regenerative-braking integration and Zeta (and related) DC–DC converters used for energy transfer and battery management. We summarize sensorless rotor-position/speed estimation methods (back-EMF, observers, sliding-mode, Luenberger, hybrid approaches), power-electronics topologies that enable bidirectional energy flow during braking (Zeta, SEPIC, single-stage Zeta-SEPIC hybrids, high-gain/bidirectional converters), and system-level designs that combine MPPT, battery charging, and regenerative capture. For each selected paper we give a focused paragraph describing methods, results, and relevance to sensorless PMBLDC + solar-PV EV architectures. We identify open problems — low-speed position estimation during startup, bidirectional converter efficiency, seamless MPPT + regenerative energy routing, and real-world validation — and propose research directions: robust low-speed observers, integrated single-stage bidirectional converters optimized for PV + regenerative flows, and hardware demonstrations on prototype EV platforms.*

Keywords: Sensorless control, PMBLDC, BLDC, back-EMF estimation, Zeta converter, bidirectional DC–DC, regenerative braking, solar-PV, battery-fed EV, MPPT, observer

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