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Advanced Drive System for DC Motor Usingmultilevel DC/DC Buck Converter Circuit

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Abstract: *This paper focuses on the design and analysis of a speed drive for a Permanent Magnet DC (PMDC) Machine using MATLAB/SIMULINK as a simulation aid. The speed drive is designed for fast dynamic speed and current response in all four quadrant of the motor's torque- speed plane. The DC motor's mathematical model is used for characterizing the system, PID/PI controllers are designed and tuned with methods including (MATLAB tuning, particle swarm optimization (PSO) and Internal Model Control). Two control strategies, single loop PID and cascaded PI loops, were studied. The cascaded PI control was used for developing the speed drive of the PMDC machine which was tuned for a current loop bandwidth of 2π.600 rads/s and a current limiting logic was implemented in the current loop of the controller. The PMDC machine's speed was controlled using voltage control method with the use of Full bridge DC-DC power converter. Metal–oxide–semiconductor field-effect transistor (MOSFET) was used as the switch. The switching was done using Unipolar Pulse Width Modulation technique due to its positive effect on the motor's current ripples. The use of active damping and active resistance in the speed and current loop respectively was done to improve the drive performance.*

Keywords: Multilevel DC/DC converter, traditional DC/DC converter, and DC drive systems

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