IMPLEMENTATION OF MODEL PREDICTIVE CONTROL FOR THREE PHASE INVERTER WITH OUTPUT *LC* FILTER USING DSP

By
Ihab Sami Mohamed Mohamed

A Thesis Submitted to the
Faculty of Engineering at Cairo University
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Implementation of Model Predictive Control for Three Phase Inverter With Output *LC* Filter Using DSP

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Predictive control; Model Predictive Control; power conversion; uninterruptible power systems; hysteresis control; PWM control; DSP; HIL.

Summary:

Model predictive control (MPC) is an advanced method of process control that has been enormously used in industry. In recent years, there has been a rapid increase in the use of digital controllers in control systems. The control of inverters with output LC filter has a special importance in applications where the high quality voltage is needed. Several control schemes have been proposed for the control of three-phase inverter. This thesis presents a new and simple control scheme using predictive control and implementing the proposed MPC on the eZdsp F28335 kit. The controller uses a discrete-time model of the system to predict the behavior of the output voltage for all possible switching states generated by the inverter. Then, a cost function is used as a criterion for selecting the switching state that will be applied during the next sampling interval. There is no need of internal current control loops and no modulators because the gate-drive signals are generated directly by the controller.

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List of Symbols and Abbreviations

MPC	Model Predictive Control
THD	Total Harmonic Distortion
IEEE 519	The IEEE standard for total harmonic voltage distortion
UPS	The Uninterruptible Power Supply system
LRPC	Long-Range Predictive Control
DSPC	Direct Speed Control
GPC	Generalized Predictive Control
S	The switching states of the inverter
v_i	The voltage vectors generated by the inverter
V_{dc}	The dc$-$link voltage
i_f	The filter current in the vectorial form
v_c	The output voltage in the vectorial form
i_o	The output current in the vectorial form
L	The filter inductance
C	The filter capacitance
f_c	The filter cut-off frequency
$F(s)$	The Transfer function of the LC filter
T_s	The sampling time
g_N	The cost function for N step predictions
g_1	The cost function for a MPC with one step prediction $N = 1$
g_2	The cost function for the Improved MPC with two steps prediction $N = 2$
v_c^*	The output voltage reference vector
$v_{c\alpha}$	The real part of the predicted output voltage vector
$v_{c\beta}$	The imaginary part of the predicted output voltage vector
$v_{c\alpha}^*$	The real part of the reference output voltage vector
$v_{c\beta}^*$	The imaginary part of the reference output voltage vector