



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

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Ihab Sami Mohamed Mohamed

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
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In
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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
<i>THD</i>	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
<i>S</i>	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 <i>LC</i> 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