Ain shams university
Faculty of engineering
Electric power and Machines department

A new technique to voltage sag ride through for adjustable speed drives.

M.Sc. thesis By:

Eng. Soha Mansour Badawy

A thesis submitted to the Faculty of Engineering –Ain Shams University
in partial fulfillments of the requirements for the M.Sc. degree in
Electrical Power and Machines Engineering.

Supervised by:

Prof Dr. Ahmed Abd-El-Sattar Abd-El-Fattah
Electric Power and Machines Department
Faculty of Engineering, Ain Shams University

Dr. Mostafa Ibrahim Mohammed Marei
Electric Power and Machines Department
Faculty of Engineering, Ain Shams University

Cairo 2010

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SUPERVISORS COMMITTEE

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Name, title and affiliation Signature

Prof. Dr. Ahmad Abd El-Sattar Abd El-Fattah
Electric power and Machine department,
Faculty of engineering, Ain shams university

Dr. Mostafa Ibrahim Mohamed Marei
Electric power and Machine department,
Faculty of engineering, Ain shams university.

EXAMINERS COMMITTEE

Name: Soha Mansour badawy

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Name, title and affiliation Signature

Prof. Dr. Samir Sayed Abd El-Hamid
Faculty of engineering,
Helwan university.

Prof. Dr. Hamdy Saleh Khalil El-Gohary
Electric power and Machine department,
Faculty of engineering, Ain shams university.

Prof. Dr. Ahmad Abd El-Sattar Abd El-Fattah
Electric power and Machine department,
Faculty of engineering, Ain shams university.

STATEMENT

This thesis is submitted to Aim Shams University in partial fulfillment of the requirements of M.Sc. degree in electrical engineering.

The included work in this thesis has been carried out by the author at the department of electrical power and machines, Ain Shams University. No part of this thesis has been submitted for a degree or a qualification at any other university or institution.

Name: Soha Mansour Badawy

Signature:

Date: 28/7/2010

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Abstract

Adjustable speed drives (ASDs) are used widely in process control and energy conservation systems. However, voltage sags are the most important power quality problems facing many commercial and industrial users. ASDs are susceptible to voltage sags occurring in the electric power system, causing them to trip, thus interfering with the continuous process and results in financial losses. There are different techniques to enhance the ride-through capability of ASDs during voltage sag condition. They are aimed at maintaining the DC bus voltage constant during the sag, allowing the motor to continuously operate during abnormal supply conditions.

This thesis presents a voltage sag ride-through system for ASDs based on a DC/DC boost converter. The proposed boost converter controller works in current mode control (CMC), which has faster response, better stability, and better safety than voltage mode control (VMC). CMC consists of two nested loops, one for regulating the DC bus voltage, whereas the other to regulate the converter input current, thus protecting the system from overcurrent. Hysteresis current control (HCC) is adopted for current regulation, which has many advantages such as high bandwidth, simple structure, fast dynamics, and easy to realize.

The voltage regulation loop is realized using a PI controller to process the error between the reference value and the actual DC bus voltage. The output from the PI controller is the reference signal for required coil current to achieve the desired voltage compensation level. Adaptive Linear combiner (ADALINE) is utilized for the online tracking of the AC supply voltage envelope to detect the voltage sag. The ADALINE possess a high tracking capability with fast convergence, and light computational burden, which lead to fast detection of the voltage disturbance, and consequently fast action of the booster controller.

Simulation results using MATLAB/SIMULINK program are presented for both types of ASDs; AC and DC, to examine the dynamic performance of the proposed sag ride-through system under different types of supply faults. In all cases, the proposed compensation system succeeded in regulating the DC bus voltage accurately at its set point

with fast response. In addition, the coil current is limited to its upper and lower bands given by the HCC. Accordingly the ASD continued working without any interruption with the same speed and torque regardless of the supply disturbance.

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