



Converter Control with Reduced Link Capacitor

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a cost-saving design that reduces the size of DC link capacitors.

This technology would apply to three-phase power applications where either volume or weight reduction is critical, or where reliability can be extended by replacing the electrolytic capacitors with fewer film capacitors.

Overview

A converter is an electrical device for converting electrical energy from one form to another, such as between alternating current (AC) and direct current (DC), between different voltages or frequencies, or a combination of these. Three-phase electric power requires the use of power converters to control the flow of electric energy by supplying voltages and currents in a form that is optimally suited for the load.

Conventional three-phase AC converter topologies use an intermediate capacitive DC link. In the case of inverters, rectifiers and frequency converters, the DC link capacitor is sized to store enough energy to maintain several tens of cycles of the AC quantity at the rated power, which requires the use of large capacitors, commonly referred to as 'bulk' capacitors, and which tend to dominate the weight and volume of most converter technologies.

UW-Madison researchers previously discovered a new modulation method for three-phase power converters called the Stored Energy Modulation (SEM) method. Their invention uses the DC link to store only enough energy to provide one high frequency switching cycle of AC output power, instead of the traditional several tens of cycles. This allows for the use of smaller DC link capacitors since the energy stored is much smaller.

The Invention

Building on their work, the researchers have now developed an improved modulation method that allows for the use of conventional switches. This new method tightly integrates the control of the source and loads, which is not traditionally done with current methods.

Reducing the energy at the DC bus led the inventors to modify how the source and load are controlled. Their method determines the switching intervals of the various solid state switching devices of the power conversion system in an integrated fashion and places them within each switching period in a particular sequence. This is determined by the desired voltage and current waveforms such that the stiffness of the DC link can be maintained without large amounts of energy storage, or additional voltage penalty compared to conventional approaches. New parameters for the source and load integration are factored into the controller algorithms.

Applications

- Three-phase power uses where volume and/or weight reduction is critical
- Electric motors (industrial automation, automotive), marine, aerospace and solar

Key Benefits

- Design saves cost, weight and volume.

Additional Information

For More Information About the Inventors

- [Venkata Giri Venkataramanan](#)

Tech Fields

- [Engineering : Power electronics & control systems](#)

For current licensing status, please contact Michael Carey at mcarey@warf.org or 608-960-9867