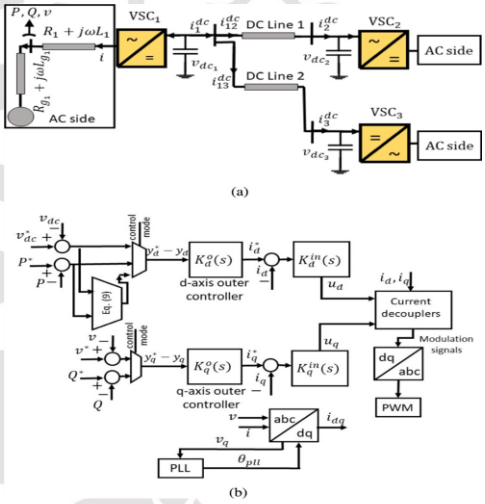
TRANSFORM

Energy Systems through Game-changing Technology

BUILDINGS | CARBON CAPTURE AND STORAGE | FUEL CELLS | NUCLEAR | POLICY | **PLANNING**
RENEWABLES | SMART GRID | STORAGE | SUSTAINABLE MOBILITY | SUSTAINABILITY ANALYSES



a) Single line diagram of three converters connected to a shared DC system
b) Control system of each converter

DESIGNING GRID COMPONENTS THAT PLAY NICELY TOGETHER

Prof. Sahar Pirooz Azad

The increasing demand for cost-effective and environmentally friendly energy has led to significant changes in power grids. A notable development is the introduction of multi-terminal direct current (MTDC) systems, which facilitate long-distance power transmission and the integration of renewable energy sources into the grid. In an MTDC setup, the direct current (DC) network is linked to the alternating current (AC) grid through multiple voltage-sourced converters (VSCs).

In large, complex systems, it's common for various companies to design different converters and their associated controllers. This can lead to problems, as differing dynamic responses among these converters can introduce instability when they are integrated into a single interconnected system.

To address this issue, WISE researchers Sahar Pirooz Azad and Fatemah Ahmadloo focused on developing models that allow for the independent design of control systems for each converter while ensuring seamless compatibility with neighbouring converters.

They aimed to meet two key requirements: the model needed to operate without needing access to the internal dynamics of neighboring converters, while also ensuring that the converter's dynamic response aligned with the overall system's response to prevent instability.

Azad and Ahmadloo assessed various models for converters across different modes, including DC voltage control, active power control, and droop control. Subsequently, they validated these models through time-domain simulations and tested their effectiveness with a range of control parameters.

Through this research, the WISE engineers are streamlining the control design of large-scale systems by decomposing them into smaller, manageable systems, all while maintaining stability.

Researchers: *Sahar Pirooz Azad, Fatemah Ahmadloo*

Source: *Ahmadloo, F., & Azad, S. (2023). Identifying suitable DC system models for an independent design of VSC controllers in MTDC grids. International Journal of Electrical Power & Energy Systems, 153, 109380.*

.

READ ARTICLE

wise.uwaterloo.ca

WISE
WATERLOO INSTITUTE
FOR SUSTAINABLE ENERGY

UNIVERSITY OF
WATERLOO