MODELLING, ANALYSIS AND CONTROL OF DOUBLY – FED INDUCTION GENERATORS

by

M. Sreenivasulu

Under the guidance of

Dr. B. P. Muni

GM, PES

BHEL R &D, Hyderabad.

Dr. K. Ramesh Reddy

Principal & HOD (EEE)

GNITS, Hyderabad.

- Abstract
- Introduction
- DFIG Based Wind Turbine With ESS
- Structure of ESS and Control Circuit of Chopper
- Control of GSC Without Fault
- Control of GSC During Fault
- Control of RSC Without Fault
- Control of RSC During Fault
- Control of Pitch Angle
- Fuzzy PSO Control for PI Controllers
- Discrete-Time PID-type FLC Structure
- PSO tuned Discrete-Time PID-type FLC Structure
- References

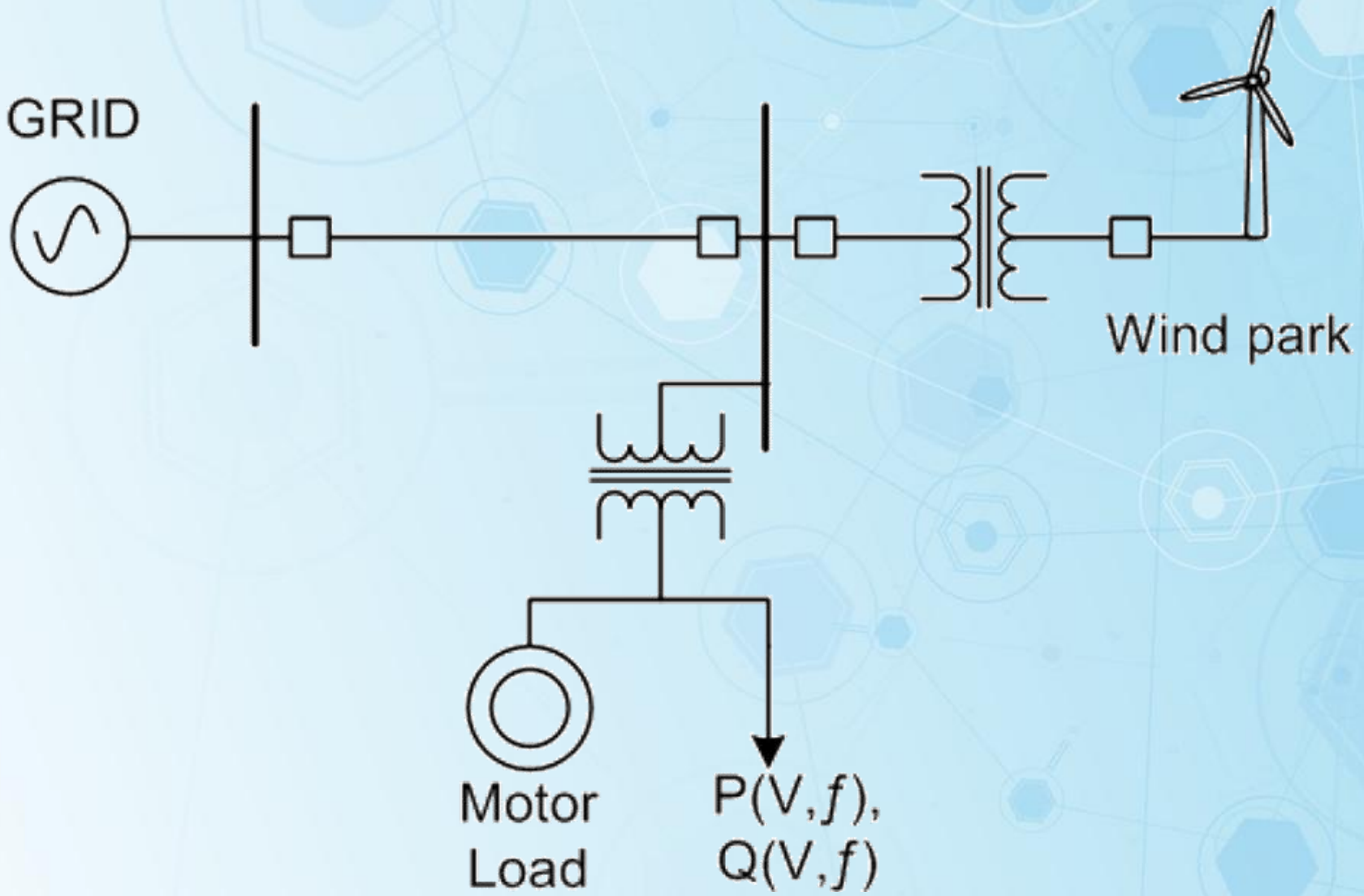
Abstract

Increase in demand of electrical power and reduction in conventional fuels emphasized the research on renewable energy sources. Among the various renewable energy sources, wind and solar has a considerable contribution as compared to other renewable sources. Doubly fed induction generators (DFIG) are found to be the most widely manufactured wind generators. Present work discusses on modelling of DFIG with fault ride through (FRT) capability.

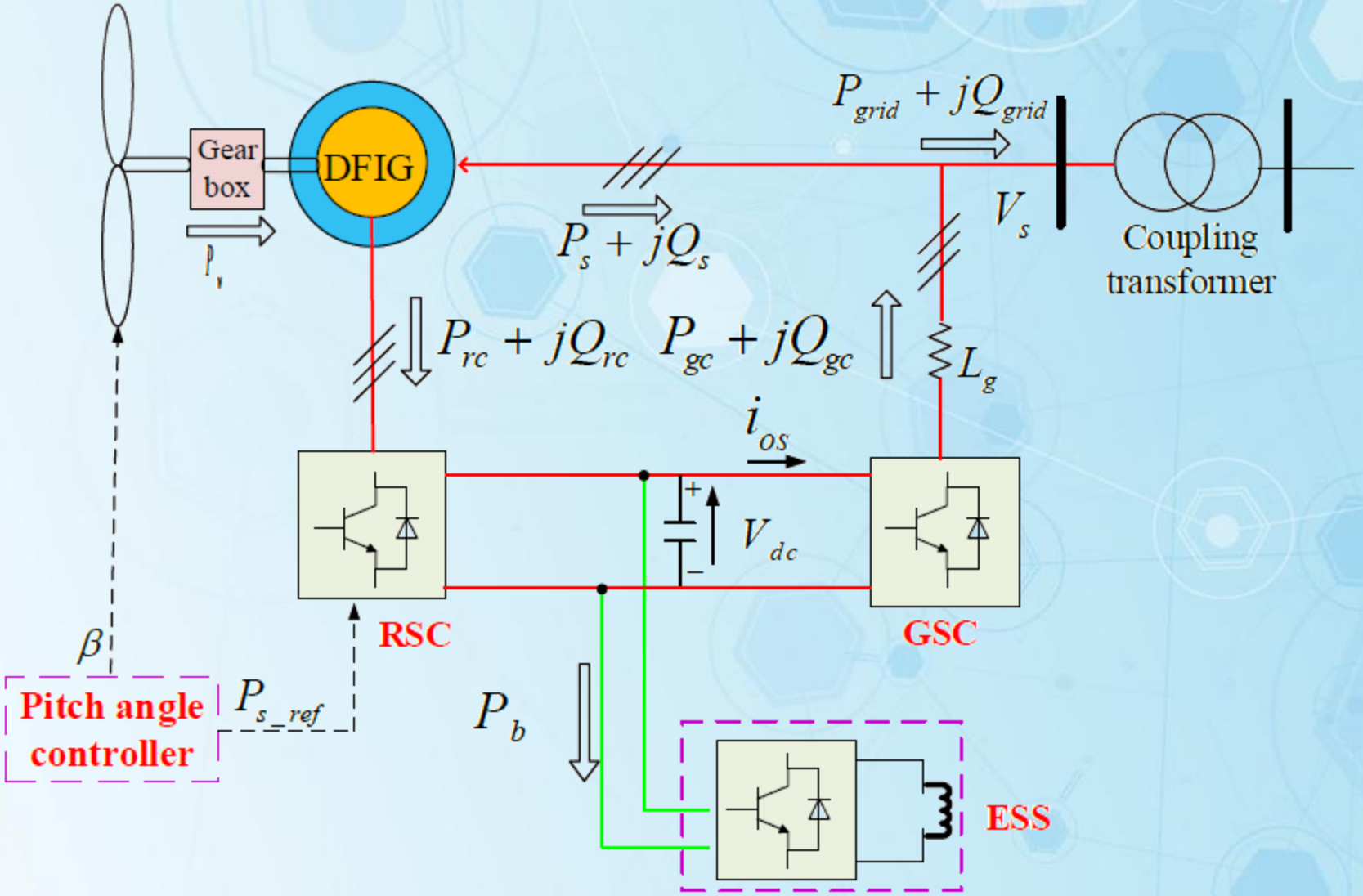
Introduction

With the increased penetration of wind electric power into grid, the wind generators are required to have FRT capability for maintaining a stable grid connected system. In the present work, the FRT capability of DFIG is met by using superconductor magnetic energy storage (SMES) as alternate energy storage system (ESS).

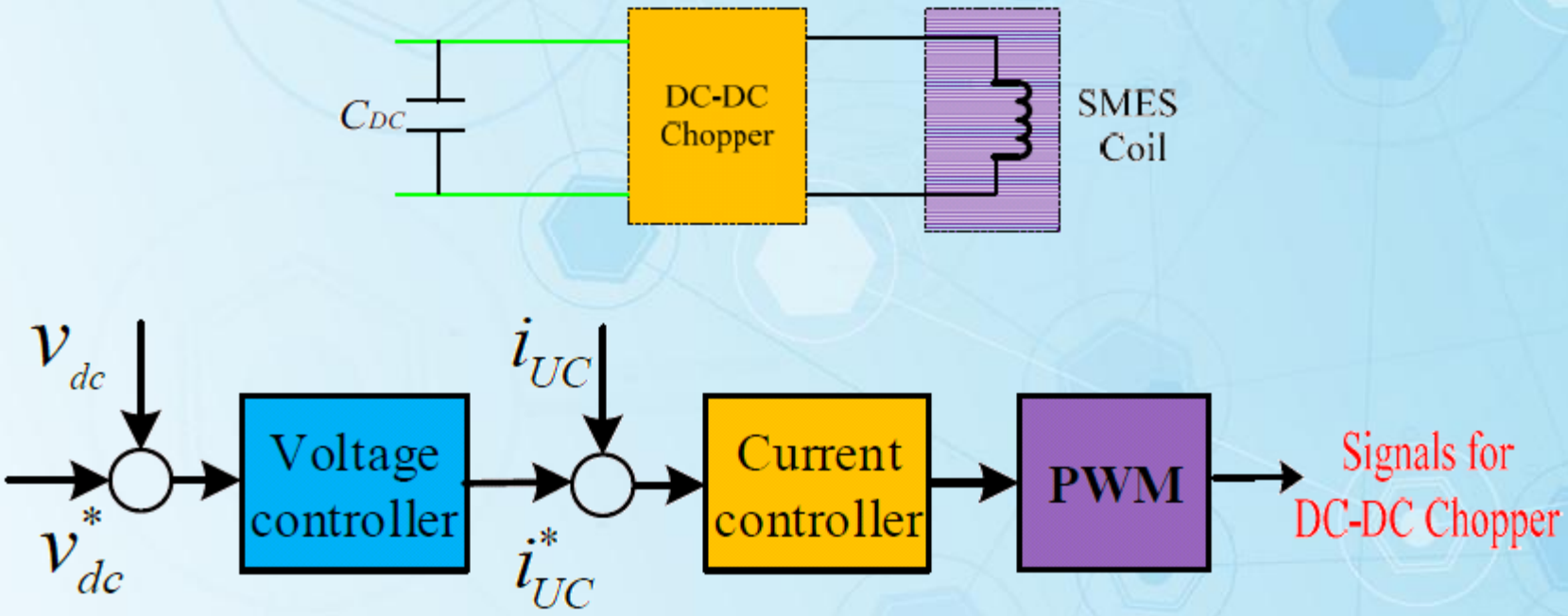
Wind farm connected to grid with local loads



DFIG Based Wind Turbine With ESS

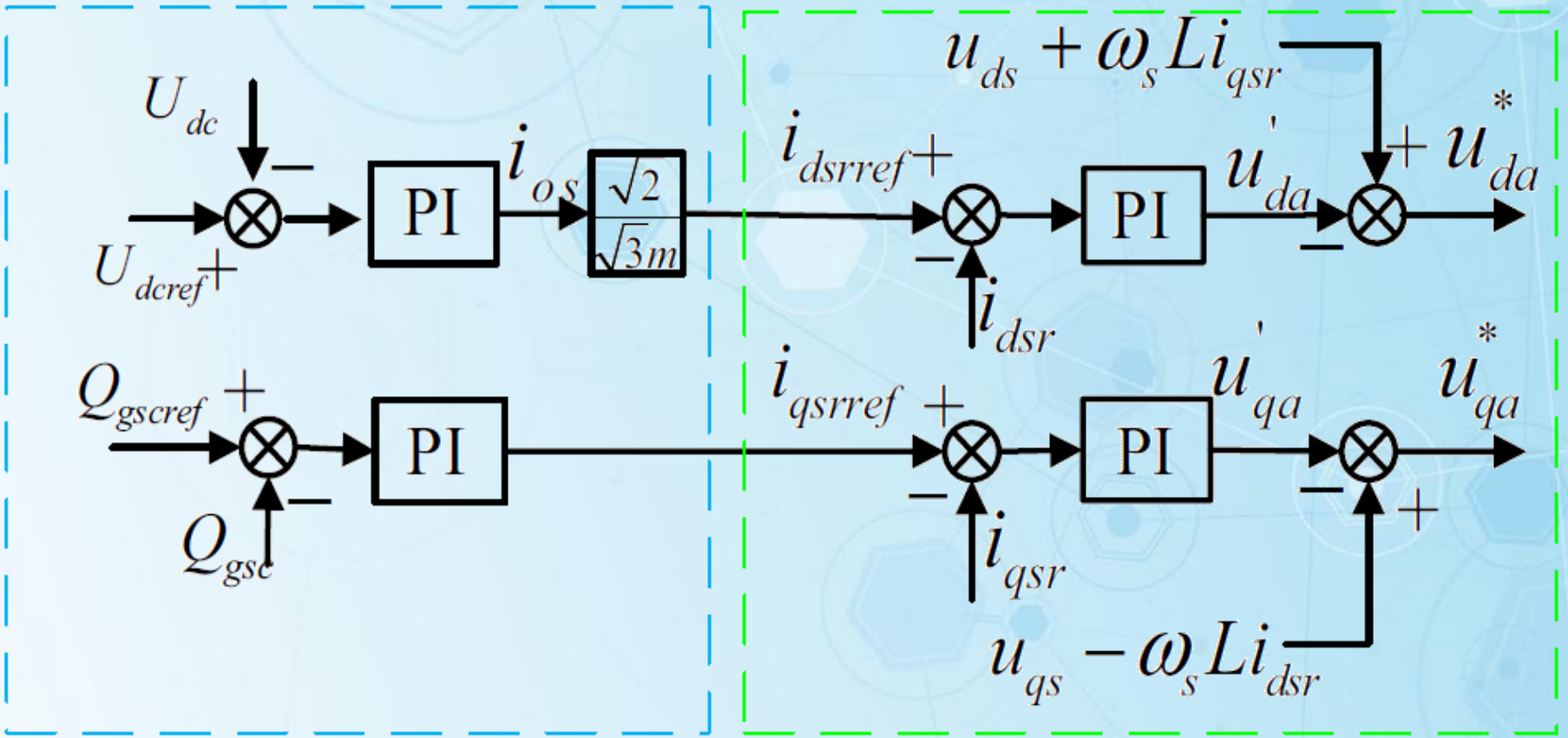


Structure of ESS and Control Circuit of Chopper

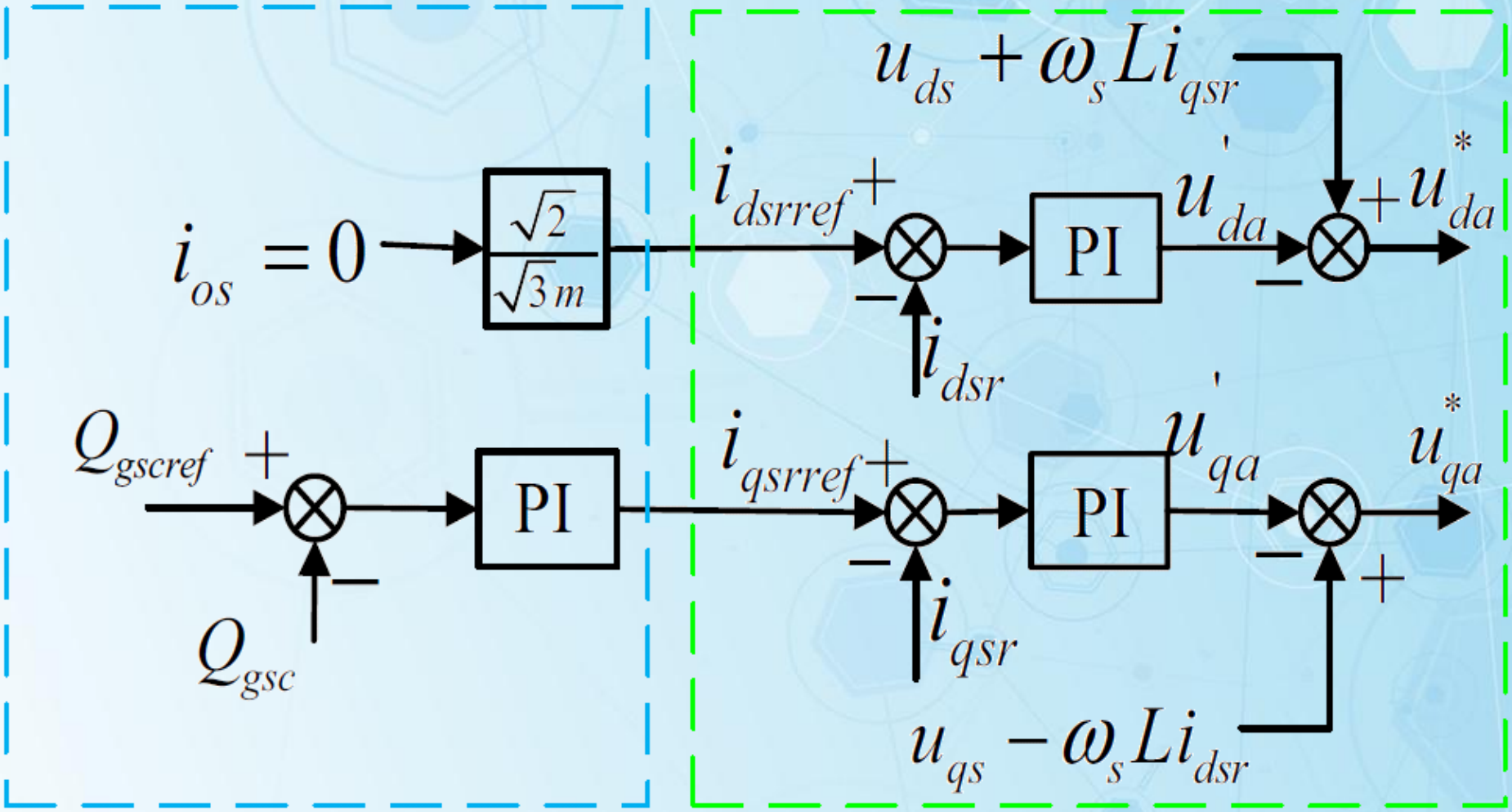


Slower outer control loops regulate d- and q-axis current reference set point and inner faster current loops regulate the current to track the reference current.

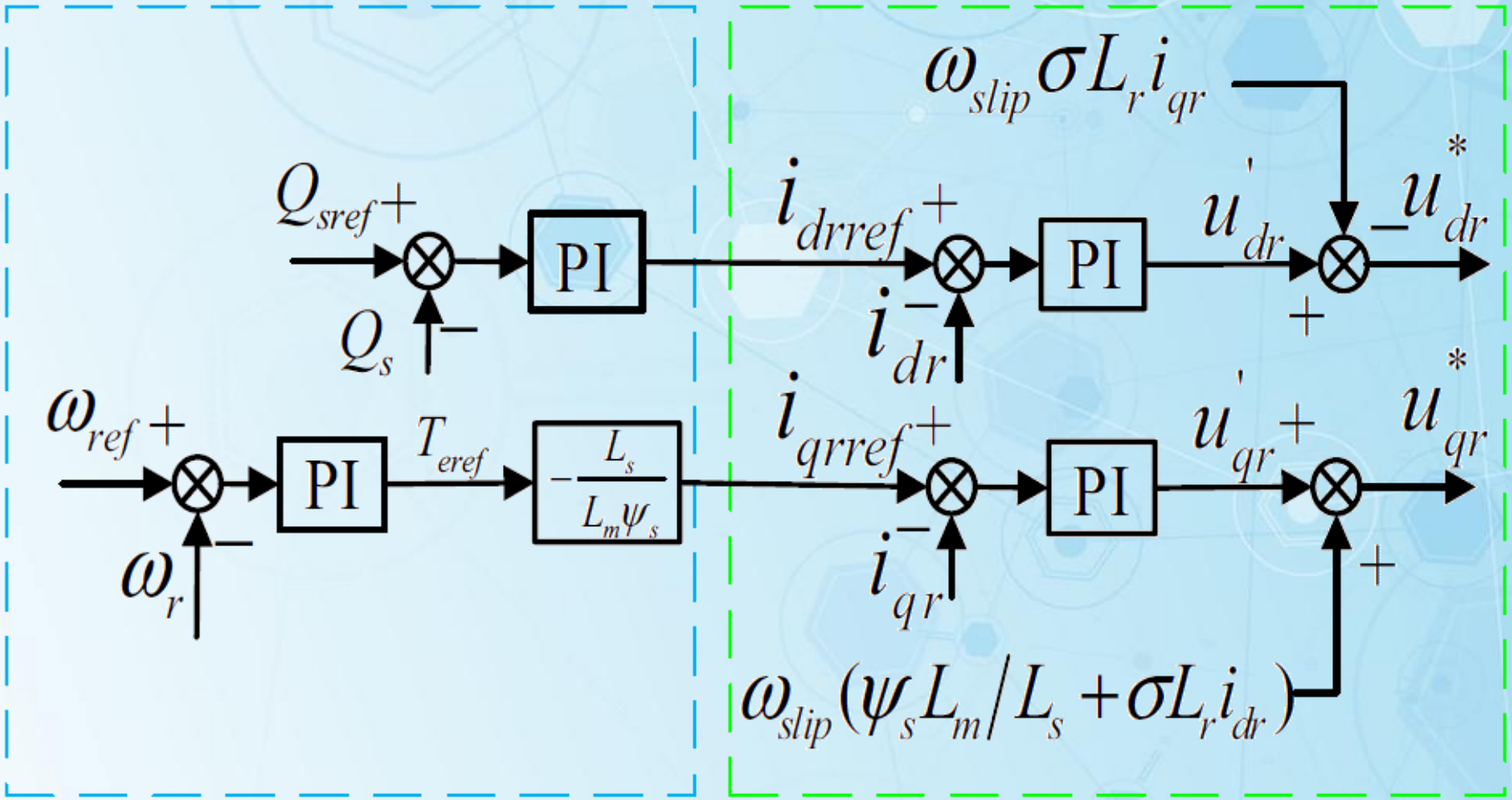
Control of GSC Without Fault



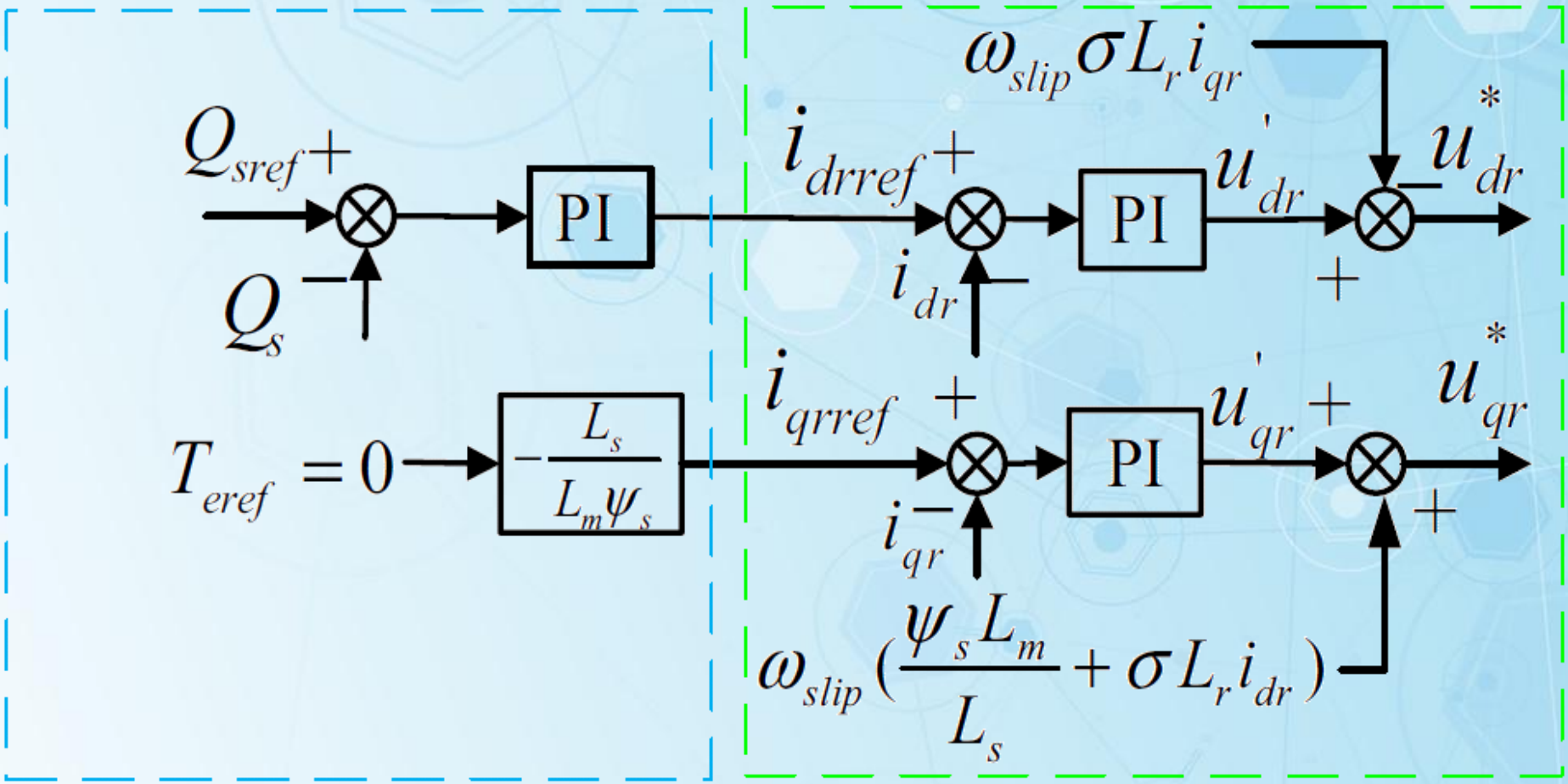
Control of GSC During Fault



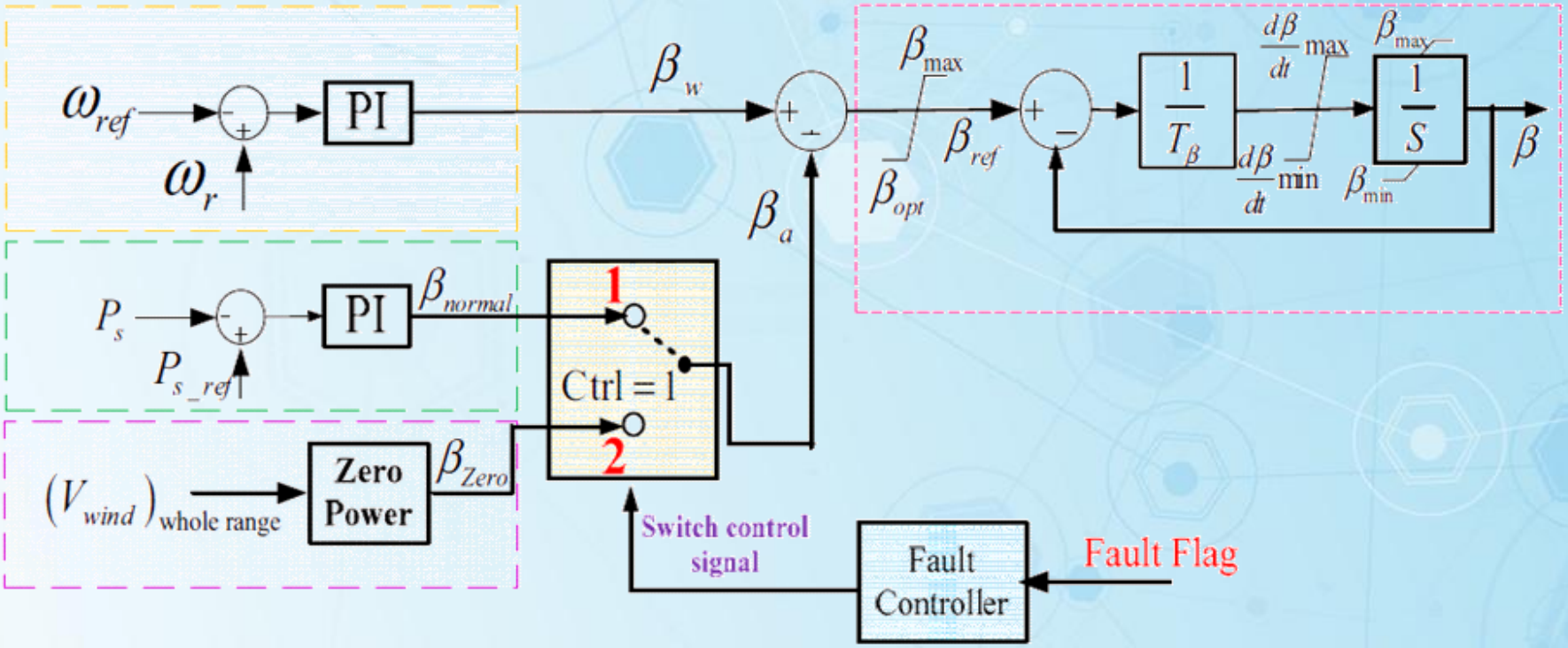
Control of RSC Without Fault



Control of RSC During Fault



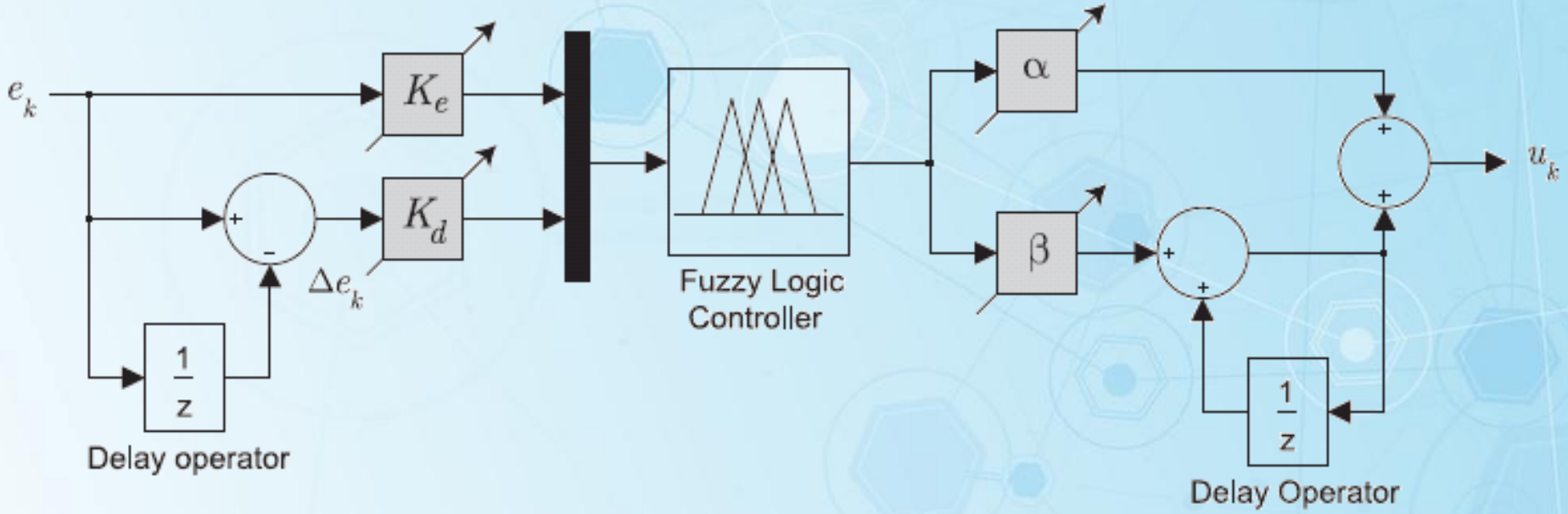
Control of Pitch Angle



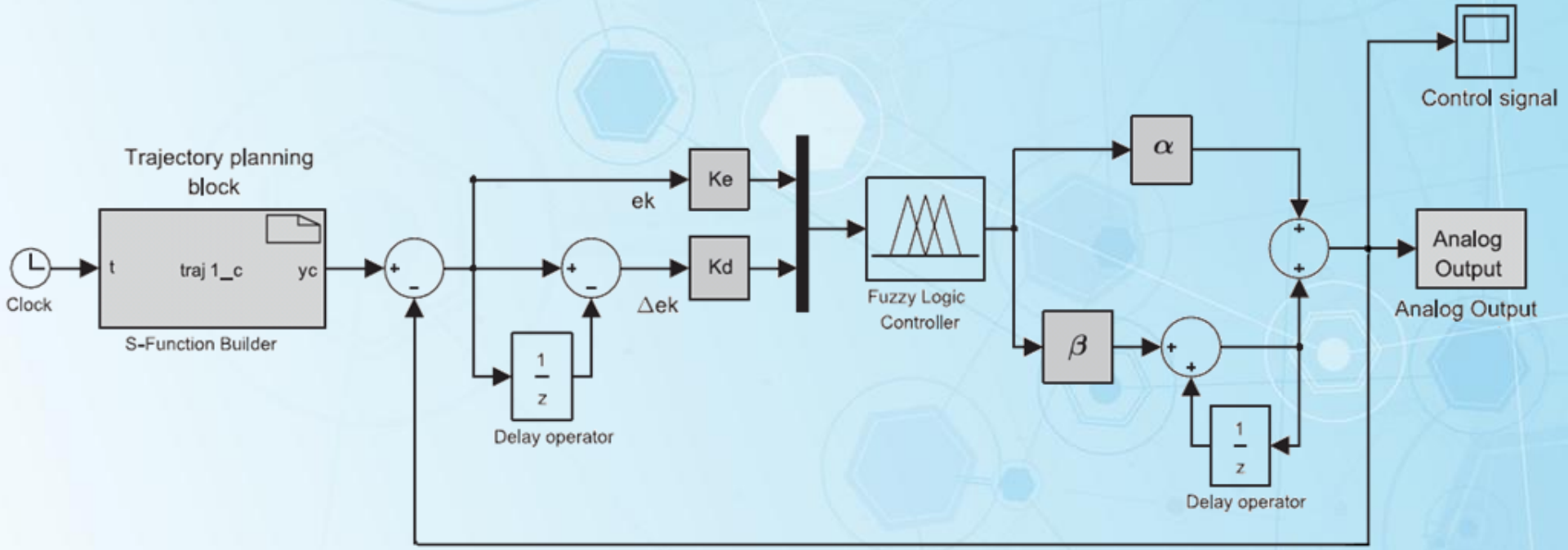
Fuzzy PSO control for PI Controllers

In present work, for efficient control of active and reactive power flow, fuzzy logic is used and to optimize the parameters of PI controllers PSO algorithm is employed. The robustness and efficiency of the control system is compared with that of conventional PI controllers.

Discrete-Time PID-type FLC Structure



PSO-tuned PID-type FLC Structure



References

1. **Yangwu Shen et. al., "*Novel Control of DFIG with ESD to Improve LVRT Capability and to Perform Voltage Support during Grid Faults*" IEEE International Conference on Energy Internet, 17-21 April 2017.**
2. **N. Mendis et. al., "*Management of Low- and High-Frequency Power Components in Demand-Generation Fluctuations of a DFIG-Based Wind-Dominated RAPS System Using Hybrid Energy Storage*" IEEE TRANSACTIONS ON INDUSTRY APPLICATIONS, VOL. 50, NO. 3, MAY/JUNE 2014**
3. **Siavash Beheshtaein, "*FAΘPSO Based Fuzzy Controller to Enhance LVRT Capability of DFIG with Dynamic References*", IEEE 23rd International Symposium on Industrial Electronics, 1-4 June 2014.**
4. **S. Bouallegue, J.Haggege, M.Ayadi n, M.Benrejeb, *"PID-type fuzzy logic controller tuning based on particle swarm optimization"*, Engineering Applications of Artificial Intelligence , Volume 25, Issue 3, April 2012, Pages 484-493.**

Thank you