Research and Development of Wind Turbine Control

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Supporting Tools

- *Developed Wind Turbine Simulator*
- *Developed Signal Controller (DSC) Board*
- *Interface system between DSC Board to microcomputer for data acquisitions*

Controller

The research is based on fixed pitch wind turbines.

Below Rated Power Region

- Maximum Peak Power Controller (MPPT)
- Feed forward
- Fuzzy Logic Control (on going)

Above Rated Power Region

- Stall regulation for power limit

Generator Types

- Dc Generator
- Synchronous (on going)
- Double Fed Induction Generator (on going)
- Cage Rotor Induction Generator (Future works)

Supporting tools

Wind Turbine Simulator
Developed DSC Board
Data Acquisition System

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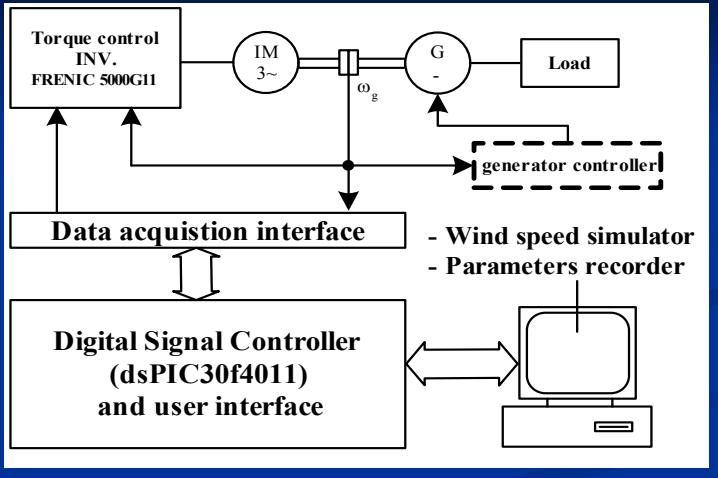
Wind Turbine Simulator Hardware Structure



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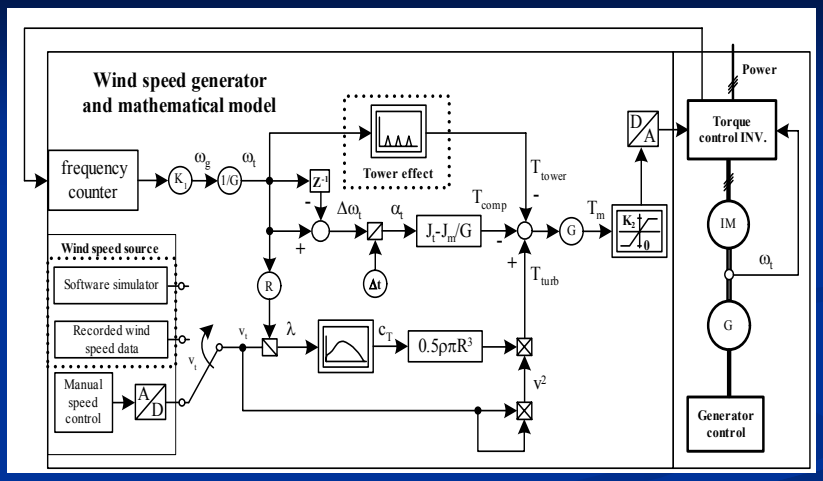
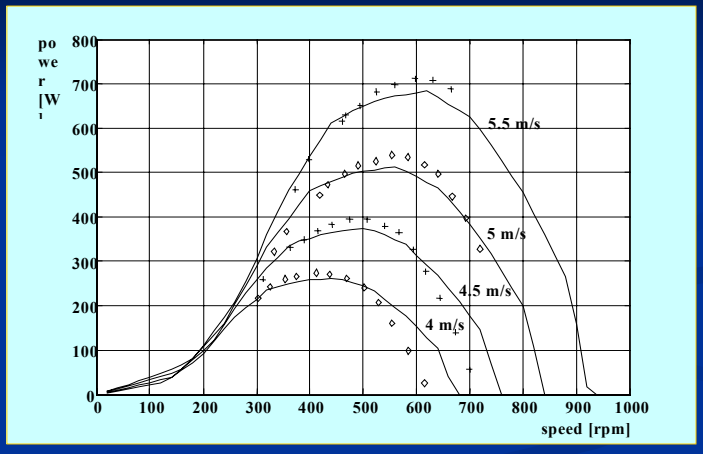
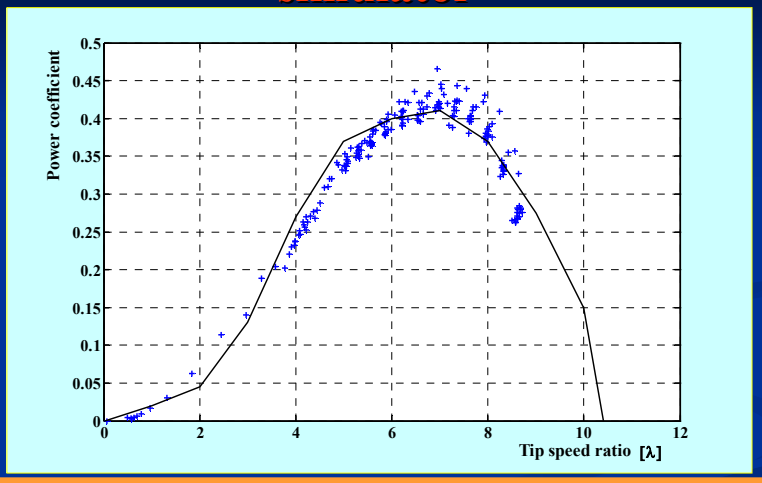
Signal Flow of Wind Turbine Simulator



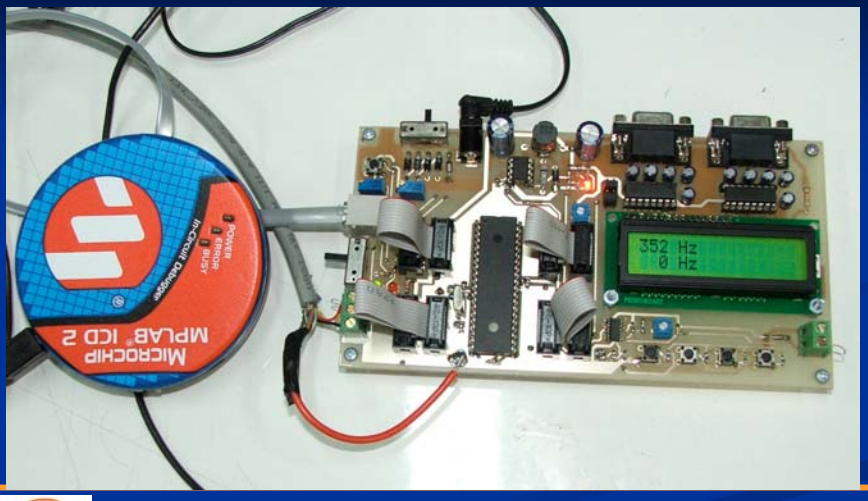
Characteristic of the developed wind turbine simulator



Power coefficient c_P of the wind turbine simulator

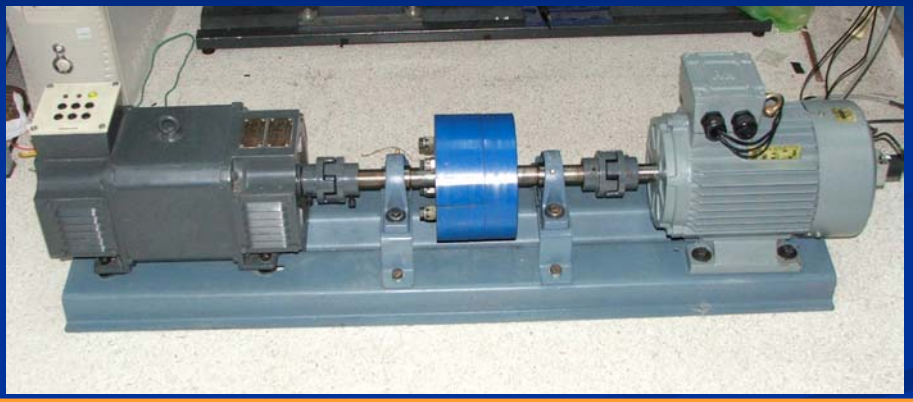


Digital Signal Controller) Board



Experimentation System

Induction motor coupling with DC generator and rotary encoder



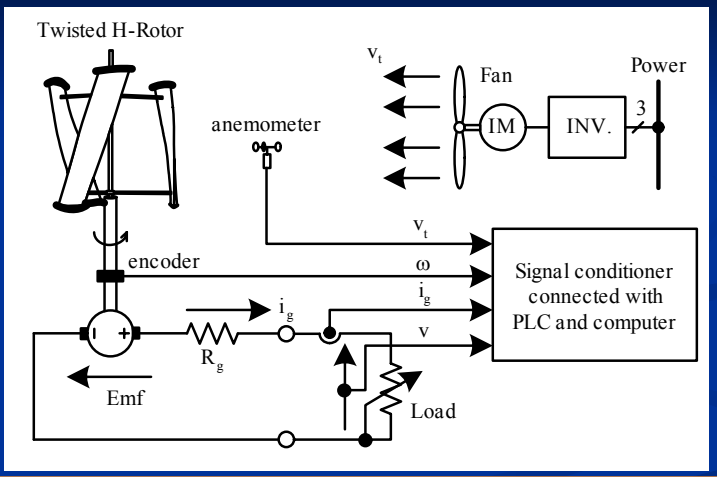
Controller

MPPT Controller
Feed Forward Controller
Fuzzy Logic Controller

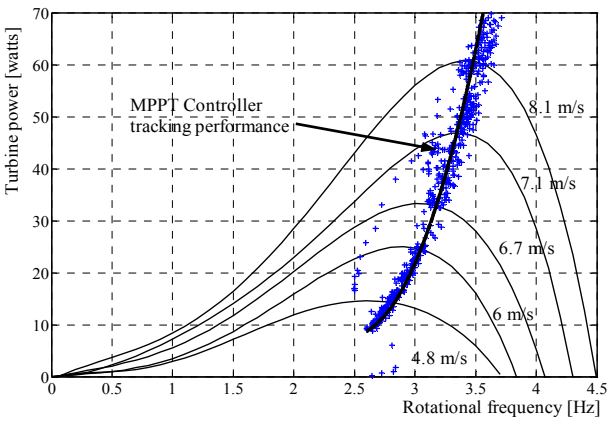
H and Twisted H-Rotor

MPPT with New Twisted H-Rotor
in Hochschule Bremerhaven, Germany.

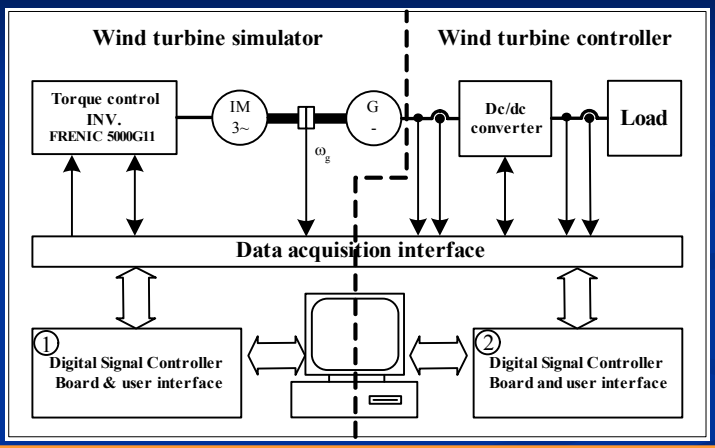
Diagram for the Determination of Twisted H-Rotor Characteristics



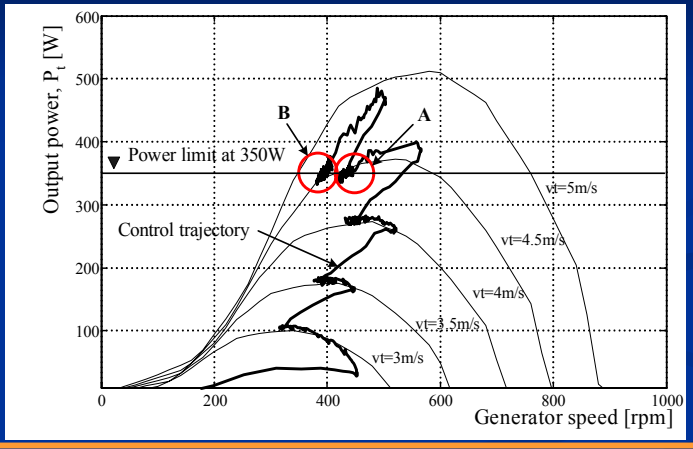
Tracking Performance of MPPT Controller



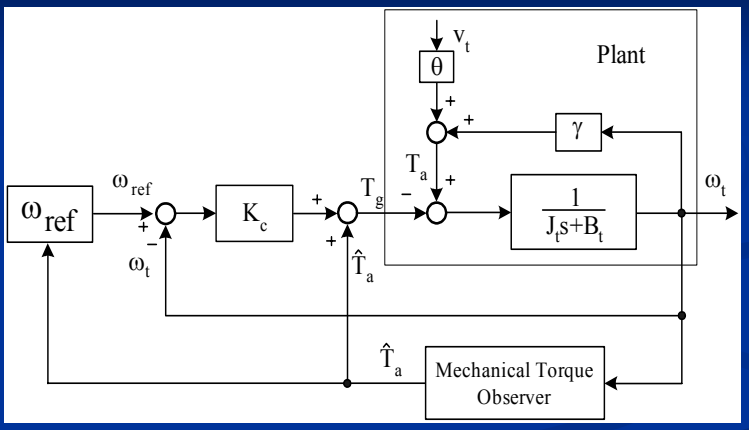
Wind Turbine Simulator Connected with MPPT and Feed Forward Controllers



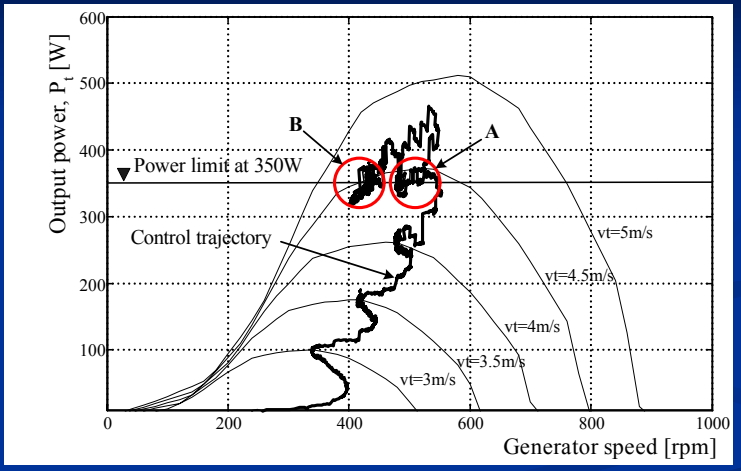
MPPT Controller



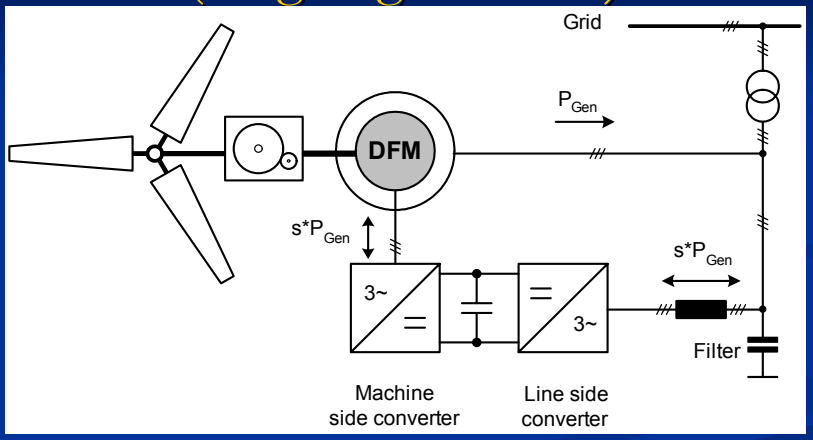
Feed Forward Control Block Diagram



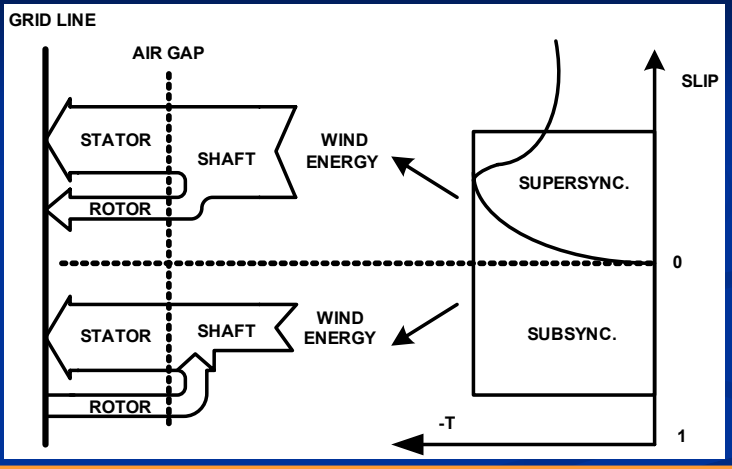
Feed forward Controller



Doubly Fed Induction Generator
(on going research)



Operating of the DFIG



Conclusion

- Various wind turbine characteristics can be programmed.
- Wind speed profiles can be easily programmed: wind speed data, Van Der Hoven model and manual set up.
- The developed simulator was implemented by a low-cost, high-performance DSC controller
- The wind turbine simulator can perform satisfactorily under steady state wind profile, turbulence and tower effect.

Conclusion

- Data acquisition: parameters such as wind speed, output torque, torque coefficient, output power, power coefficient, and tip speed ratio.
- The developed MPPT and stall regulation controller can be effectively coordinated covering the overall range of wind turbine operation.
- The developed MPTT does not require any knowledge of a machine model, turbine characteristic curves and wind speed sensors.
- The developed MPPT would be useful in case of, for example, dirty blades, local air flow effects or mispitched blades because these factors change the characteristics of the wind turbine but the proposed control strategies do not affected by such factors.