

Development of Grid Forming Converters for Secure and Reliable Operation of Future Electricity Systems

View From An NGN Member

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For power system expertise

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About Me

- Software and Control Engineer, Siemens Gamesa. Since Mar 2019
Research, develop and maintain the converter control algorithm and software for wind turbines
- PhD University of Birmingham, 2016 - 2019
Modelling and control of multi-level converter for offshore wind farm applications
- CIGRE Next Generation Network (NGN)
Secretary and Treasurer, 2021 –2022
Vice Chair, since Nov 2022
- CIGRE Technical Committee (TC)
Secretary, since Oct 2022

Benefits Of Participating In Working Group

1. Address key issues and challenges of cutting-edge technologies
2. Learn from more experienced experts within CIGRE
3. Broaden social network with enthusiastic individuals from different background
4. Enhance skills
 - Writing skill – technical brochure, Electra report
 - Communication skill
 - Etc.

How To Get Involved

- Be a CIGRE member (NGN, individual or collective)
- CIGRE Website working group opportunities
<https://cigre.org.uk/news-2/working-group-opportunities/>
- Subscribe CIGRE mailing list
New Working Group Members Required
- Monthly newsletter/ Technical Committee Annual Report

My Responsibilities As An NGN Member

1. Survey (meeting options, sub-group selections etc.)
2. Arrange meetings, meeting minutes
3. Data management platform, e.g. KMS

CIGRE B4/C4.93 Grid Forming Pre-meeting Survey

SUMMARY → DESIGN SURVEY → PREVIEW & SCORE → COLLECT RESPONSES → ANALYZE RESULTS → PRESENT RESULTS

QUESTION BANK ?

Build

Style

Logic

Options

Question Bank

Format

Search for questions

Recommended Questions >

Previously Used Questions >

All Categories >

Community >

Customer Feedback >

Customer Satisfaction >

Page Logic ▾ More Actions

3. Following the last question, if you have any comment or suggestion to the TB layout, please write it here: 0

4. What is your favourite Subgroup for TB Chapter contribution (Single Option)? 0

Subgroup 1 - Definition of Grid Forming Converters (GFCs) as connected into Power Systems.

Subgroup 2 - Provision of System Services from GFCs for Secure and Reliable Operation of Future Power Systems.

Subgroup 3 - Analysis Tools for Planning, Design and Operation of GFC Applications.

Challenges

1. Time difference among members across the globe
 - Arrange two sessions for big group meetings when necessary
 - Make use of tools: survey, recording..
 - Shorten meeting length
 - Physical meetings (occasional)
2. IT issues
 - Accessibility of KMS, Google drive etc.

A Site Test Experience On Grid Forming From Siemens Gamesa

- First UK converter-connected wind farm to operate in grid-forming
- 23-turbine, 69 MW farm, GF for 6 weeks in 2019
- Direct-drive full-converter PMSG (D3)

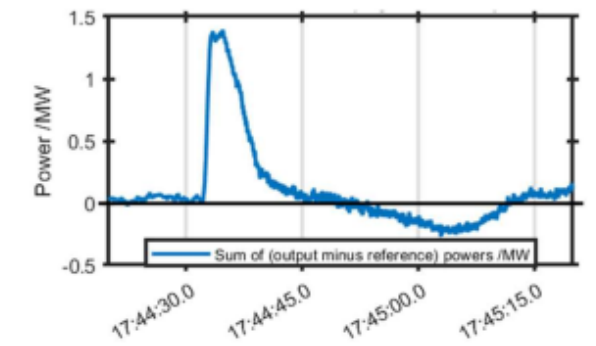
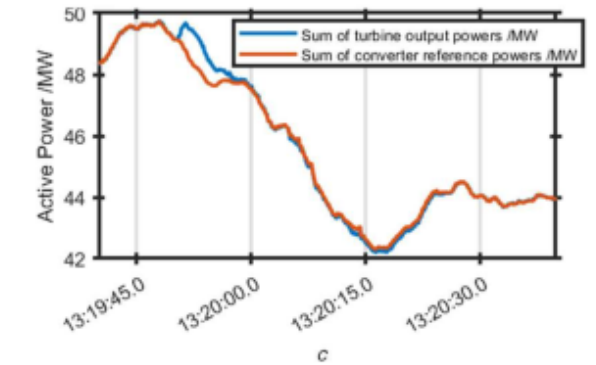
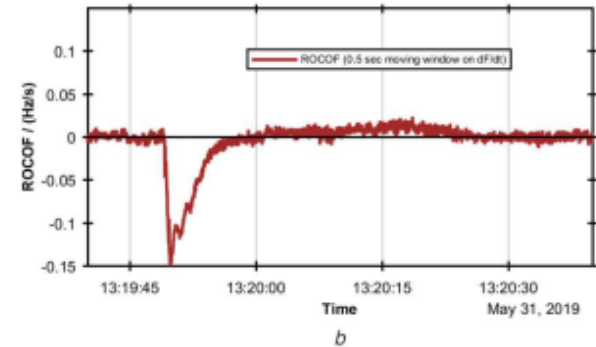
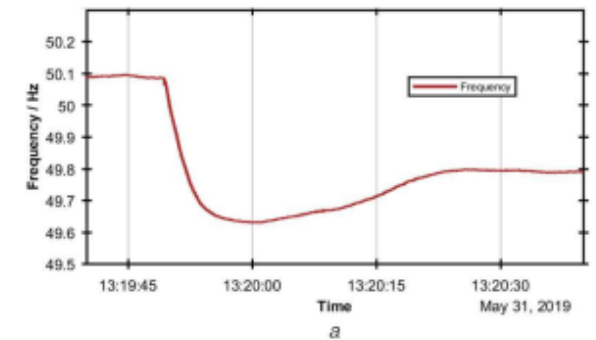


Continue1 – SGRE Grid Forming

1. Event 1

- IFA (Interconnexion France-Angleterre) tripped, 31 May 2019
- Infeed loss of ~1 GW, ROCOF peaked at ~ -0.11 Hz/s, frequency drop of nearly 0.5 Hz
- Turbine setting $H = 4s$
- Prediction is ~1.2 MW, which matches measurement

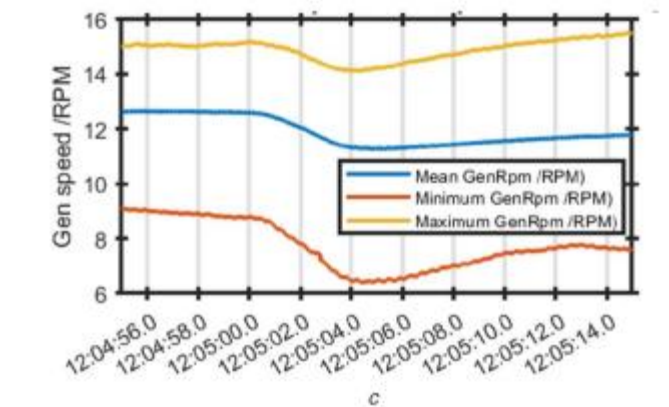
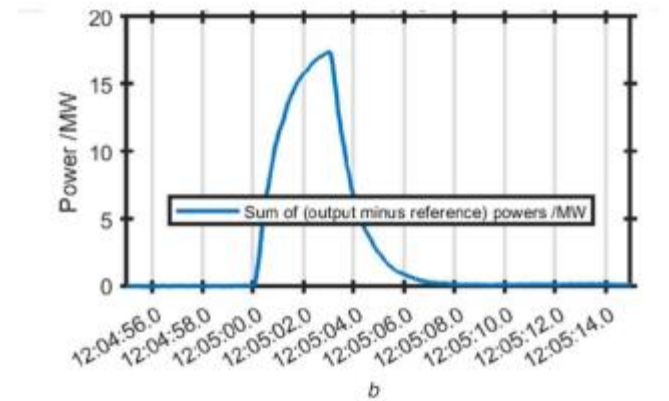
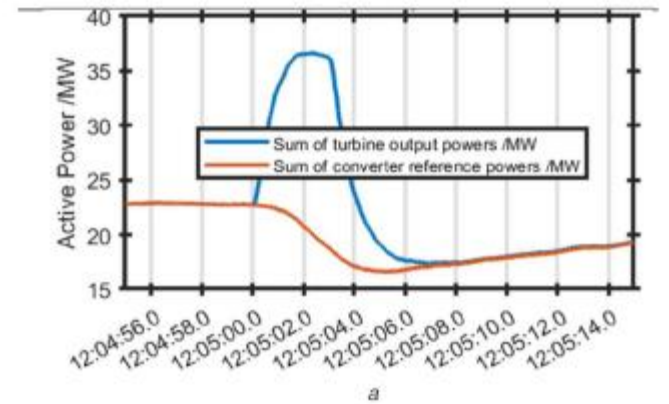
$$\Delta P \approx -\frac{2 \times H \times S_{\text{Rating}}}{f_0} \times \frac{df}{dt}$$



Continue2 – SGRE Grid Forming

1. Event 2

- Synthetic event, -1 Hz/s , 3 Hz drop. farm H = 8 s
- Reductions in rotor speed are significant
- Limits on WTG, without additional energy storage or pre-event curtailment
- Possibilities: Various H real-time; Energy storage etc.



Thank you!

- LinkedIn: www.linkedin.com/in/jiajie-luo
- Ref paper: <https://ietresearch.onlinelibrary.wiley.com/doi/full/10.1049/iet-rpg.2020.0638>



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