

IEEE CSS Technical Committee on Smart Grids (TC-SG)
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SUMMARY

Activities of the TC-SG during this period (January- June2013) include:

MEMBERSHIP

- **Outreach and invitation for participation:** Contacted over 450 members of the IEEE CSS, PES, and affiliated societies and invited their participation. To date 122 colleagues have joined the TC-SG. Membership is growing steadily from the genesis of this TC in June 2010: From 58 members in December 2010, to 72 in June 2011, and to 94 in December 2012 (please see the attached membership roster).

The first in-person meeting was held on Thursday December 16, 2010 at the IEEE CDC'10 in Atlanta. Since then the TC-SG has held six meetings, at every ACC and CDC conference, with robust participation of 27-58 colleagues per meeting (with the exception of CDC'12 in Hawaii, due to travel constraints, where 12 colleagues participated, had superb brainstorming and discussions), providing terrific feedback with a high level of enthusiasm.

Areas discussed and delivered include:

- Discussed and planned potential collaborations for vision/roadmap for control systems for smart grids. This was a key focus area, which was successfully carried out during the past 20 months and successfully delivered. Please see below an update on the Smart Grid Vision Project for Control Systems (SGV-CS) report.
- Considered and discussed technical areas that our community can contribute to and that the TC-SG will cover.
- Sought participants in organizing sessions, tracks and activities, including special issues/sections in the upcoming IEEE journals and in the IEEE workshops/conferences, including SG tracks and invited sessions at the ACC, IFAC, and CDC/ECC.
- Coordination and planning to prepare a concise summary of challenges and opportunities for dynamical systems and controls in SG.

Activities/progress during January- June 2013:

- IEEE Smart Grid Vision Project for Control Systems:
 - Under Dr. Anu Annaswamy's leadership, as the Editor In Chief for the IEEE Smart Grid Vision for Control System (SGV-CS), the project was successfully completed in May 2013.
 - This project is sponsored by the IEEE Standards Association and focuses a long-term vision of what the smart grid will look like 20 to 30 years out what can the control systems community contribute.
 - Charter: "The SG Vision Project will be chartered with creation of a rich set of forward looking use cases, applications scenarios for SG, and corresponding enabling technologies for SG of the future snapshots of years 2030-2050 that will characterize the SG paradigm and should be the world's beacon for SG paradigm and relevant to it technologies. It should be targeted to produce publishable products (long term vision, reference architecture model(s), and a technology roadmap). The SG vision should be a pie in the sky globally optimal scenario for the SG with minimal to no boundary conditions. In other words the vision

should not be bounded by existing technological, regulatory, business paradigms, standards projects, or product plans." The TOC for the 168-page report is as follows:

Chapter 1

Introduction

- 1.1 Citations

Chapter 2

Overview of Existing Control Practice in the Electric Power Grid

- 2.1 Introduction
- 2.2 Generation setpoint control for markets and economic dispatch
- 2.3 Beyond setpoint control: stable power and frequency regulation
- 2.4 Electromechanical dynamics of primary and secondary control
- 2.5 Reactive power and voltage magnitude control
- 2.6 Communication, measurement and computational architectures supporting present day grid control
- 2.7 Interdependencies with other cyber and digital infrastructures
- 2.8 Summary
- 2.9 Citations

Chapter 3

Drivers for Change

- 3.1 Introduction
- 3.2 Driver 1: Decarbonization
- 3.3 Driver 2: Reliability in the face of growing demand
- 3.4 Driver 3: Electrification of transportation
- 3.5 Driver 4: Empowered consumers
- 3.6 Driver 5: Market designs and regulatory paradigms
- 3.7 Challenges
- 3.8 Enabling factors
- 3.9 Summary
- 3.10 Citations

Chapter 4

Control-Enabled Smart Grid: Scenarios for 2030 to 2050

- 4.1 Introduction
- 4.2 Scenario 1: Grid-scale real-time endpoint-based control
- 4.3 Scenario 2: Dynamic pricing and multi-horizon power markets
- 4.4 Scenario 3: Real-time, closed-loop, ubiquitous demand-response
- 4.5 Scenario 4: Smart periphery—coordinated and hierarchical microgrids
- 4.6 Scenario 5: Transportation electrification
- 4.7 Scenario 6: Distribution automation
- 4.8 Scenario 7: AC-DC transmission systems
- 4.9 Scenario 8: Renewable generation
- 4.10 Conclusions
- 4.11 Citations

Chapter 5

Research Challenges

- 5.1 Introduction
- 5.2 Loci of control: Innovations in current power systems
- 5.3 Loci of control: Emerging centers of activity
- 5.4 Loci of control: Grid-wise perspectives
- 5.5 Loci of control: Game-changing control architectures
- 5.6 Emerging control themes
- 5.7 Concluding remarks
- 5.8 Citations

Chapter 6

Concluding Remarks

- 6.1 Citations

Value proposition: Well-aligned with the mission of the CSS TC-SG, this project represents partnership between industry and academia and provides then following:

Value to Industry

- Exposure to early research activities
- Access to academic research talent and intellectual property
- Increase strength of intellectual property due to early patenting activities
- Increase in relevancy of patents due to targeted, standards-minded research
- Standards development can start earlier and is expected to be accelerated by pre-standardization discussions, thus reducing time-to-market for products and services

Value to Academia

- Possibility to partner with industry
- Possibility to engage in relevant to industry research
- Significantly higher possibility for impact of research
- Potential for highly cited publications - Vision Projects are meant to result in peer-reviewed publications available on IEEE Xplore

CSS TC-SG gratefully acknowledges the following colleagues for their outstanding contributions to the IEEE Smart Grid Controls Vision Project:

- Anu Annaswamy, Massoud Amin, Tariq Samad, and Christopher Demarco
- Bill Ash and Alex Gelman
- Duncan Callaway, Aranya Chakraborty, Amro Farid, Alejandro Dominguez-Garcia, Pramod Khargonekar, and Jakob Stoustrup

Over the past year, these project leaders worked tirelessly outside of their own academic and professional endeavors to conceptualize and develop the framework of the vision, and to oversee the writing and execution of this final document. As contributing editors to the document, they were instrumental in providing oversight, clarity and overall direction to the more than 30 colleagues who authored this Smart Grid controls vision.

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Angela Cadena	Himanshu Khurana
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Dennice Gayme	Tariq Samad
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Other:

- **IEEE Smart Grid Newsletter:** Invitation to submit articles to the IEEE Smart Grid Newsletter, on which Massoud Amin serves as chairman. The June issue marks the 30th monthly newsletter,

which continues to be very well received. To access the June 2013 issue and earlier articles in the Newsletter please visit <http://smartgrid.ieee.org/june-2013> where you can get a sampling of 120 posted articles (for January 2011- June 2013), for content and ideas on which to base your article.

- The Chair of the TC-SG gave 18 invited presentations and 3 keynote addresses at various conferences and workshops during January- May 2013; presentations included discussion of cross-disciplinary areas/subjects and mathematical underpinnings in Smart Grids, Sensing and Controls (and their application to automation and increased reliability, efficiency and security of power and energy infrastructure). Highlighted the CSS TC-SG and invited participants to join.
- Call for Papers: Invited Sessions on Smart Grids for the 19th IFAC World Congress in 2014 in Cape Town (<http://www.ifac2014.org/>)
 - Thanks to the Professors Kwang Lee and István Erlich who are organizing a Mini Symposium on Smart Grids within the IFAC World Congress, similar to the highly successful tracks in the 2012 IFAC Congress in Milan. Please see the enclosed Call for Papers for your participation in the Mini Symposium, either by submitting regular papers or organizing Invited Sessions. Important Dates:
 - Letter of intent with title and abstract: August 15, 2013
 - Notification to authors: September 15, 2013
 - Submission of final papers: October 30, 2013

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Upcoming meeting:

The semi-annual meeting of the IEEE CSS TC-SG will be held at the **2013 American Control Conference on Tuesday June 18, during 3:30-5:00 p.m., at the Renaissance Washington, DC Downtown Hotel** in room Congressional C:

Agenda:

- Welcome/Introductions
- Update since our meeting at the CDC in December 2012
- Sessions at the ACC:
 - 1) Sunday 6/16/2013
 - Prof. Qing-Chang Zhong, University of Sheffield
 - Workshop on smart grid integration, which is based on his research monograph entitled Control of Power Inverters in Renewable Energy and Smart Grid Integration recently published by IEEE-Wiley:
<http://wiley.com/WileyCDA/WileyTitle/productCd-0470667095.html>
 - 2) Wednesday 6/19/2013 9:30-11:30 a.m.
 - WeA18 Tutorial Session, Grand Ballroom South
 - Pathways Toward Smart, Flexible and Efficient Power Systems
 - Chair: Dr. Dennice Gayme, Johns Hopkins Univ.
 - Co-Chair: Dr. Ufuk Topcu, Univ. of Pennsylvania

 - 09:30-10:10, Paper WeA18.1
 - Towards Smart, Flexible and Efficient Power Systems: Vision and Research Challenges

Topcu, Ufuk	Univ. of Pennsylvania
Gayme, Dennice	The Johns Hopkins Univ.
Low, Steven	California Inst. of Tech.
Khargonekar, Pramod P.	Univ. of Florida

10:10-10:50, Paper WeA18.2
Convexifying Optimal Power Flow: Recent Advances in OPF Solution Methods (I)
Low, Steven California Inst. of Tech.
Gayme, Dennice The Johns Hopkins Univ.
Topcu, Ufuk Univ. of Pennsylvania

10:50-11:10, Paper WeA18.3
Management of Energy Resources for Grid Integration of Renewables
Gayme, Dennice The Johns Hopkins Univ.

11:10-11:30, Paper WeA18.4
Engaging Consumers to Increase Grid Flexibility
Topcu, Ufuk Univ. of Pennsylvania

3) Wednesday Evening 6/19/2013

Prof. Pramod Khargonekar and Dr. Aranya Chakraborty are arranging a tutorial session on Wide-Area Control of Power Systems on Wednesday evening (session WeC18 in Grand Ballroom South). The speakers for this session are: Dr. Aranya Chakraborty, Prof. Pramod Khargonekar, Prof. Joe H. Chow, Prof. Anjan Bose and Prof. Christopher DeMarco. Hope that you are able to attend.

Other pertinent papers:

He Hao, Anupama Kowli, Yashen Lin, Prabir Barooah, and Sean Meyn
11:10-11:30, Paper MoA13.6
Ancillary Service for the Grid Via Control of Commercial Building HVAC Systems
<http://humdoi.mae.ufl.edu/~pbarooah/publications/Haoetal:ACC2013.pdf>

He Hao, Anupama Kowli, Yashen Lin, Prabir Barooah, and Sean Meyn
9:50-10:10 Paper WeA13.2
A Real-Time Control Framework for Smart Power Networks with Star Topology

13:30-13:50 Paper WeB09.1
Modeling Supermarket Refrigeration Systems for Supervisory Control in Smart Grid

Next Steps:

- Develop technical areas that our community can contribute to and that the TC will cover.
- TC Co-chair transition
- Increase CSS' leadership role and visibility in smart grid education, RD&D:
 - Development of TC-SG website
 - High-visibility events, publications and activities
 - Development and delivery of CSS-focused webinar series as a vehicle to give virtual seminars on smart grids: Thanks to efforts of Dr. Rajeev Verma (Eaton Innovation Center and IEEE SEM GOLD chair) along with Prof. Aranya Chakraborty of NCSU and Prof. Alireza Sayedi of University of Rochester are developing a series.
 - Participate in the organization of pertinent activities, including special issues/sections in the upcoming IEEE journals and in the IEEE workshops/conferences.
 - Column on TC-SG for CSM

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- **Fall 2013 meeting of the CSS TC-SG** will be held at the 52nd IEEE Conference on Decision and Control, Florence, Italy, December 10-13, 2013.

**IEEE Control Systems Society (CSS)
Technical Committee on Smart Grids (TC-SG)
TC-SG members**

Note: Additions, deletions, and changes to e-mail addresses in the roster below should be reflected in the list of e-mail addresses for TC-SG members that appears immediately after the roster.

Last update: 18 Dec. 2013 (T. Samad)

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