IOWA STATE UNIVERSITY
Department of Economics, Department of Electrical & Computer Engineering

Report on:

ERCOT PNNL Contract 401882: *Start Date* 3/19/2018

Development of an Integrated Transmission and Distribution Test System to Evaluate Transactive Energy Systems

ISU Project Team:

PI Leigh Tesfatsion & Co-PI Zhaoyu Wang

Grad Research Assistant: Swathi Battula

PNNL/ISU Web Conference, 16 November 2018

ERCOT Contract: Presentation Outline

- Original Task/Milestone Schedule: M1-M3
- Updated Task/Milestone Schedule
- Work in progress for M3.2 (Swathi/LT)
- Concerns: GridLAB-D Household ETP Model

Original Task & Milestone Schedule

Milestone	Date Due	Original Description
M1	May 31, 2018	5-zone model of the old ERCOT system, posted to a web repository.
M2	Sep 30, 2018	Nodal model of the new ERCOT system, posted to a web repository.
M3	Sep 30, 2018	Submitted conference or journal paper on this work.

Updated Task & Milestone Schedule

Milestone	Date Due	Date Delivered	Fuller Descriptions of Actual Work
M1* DONE	May 31, 2018	June 5, 2018	Development of 8-Bus ERCOT model (with nodal locational marginal pricing); grid/load/gen data posted at PNNL repository
M2.1 DONE	Sept 30, 2018	August 1, 2018	Basic 8-Bus ERCOT Test System, implemented via AMES V3.1, posted at https://github.com/ITDProject/ERCOTTestSystem
M2.2 DONE	Sept 30, 2018	August 24, 2018	8-Bus ERCOT Test System (with wind power), implemented via AMES V3.2, posted at https://github.com/ITDProject/ERCOTTestSystem
M3.1 DONE	Sept 30, 2018	August 31, 2018	200-Bus ERCOT Test System (with wind power), implemented via AMES V3.2, posted at https://github.com/ITDProject/ERCOTTestSystem/tree/master/ERCOT_Test_Systems/The_200Bus_ERCOT_Test_System
M3.2**	Dec 31, 2018		200-Bus ERCOT Test System (with wind power), implemented via AMES V5.0, to be posted at PNNL/ISU repositories.
M3.3**	Dec 31, 2018		Conference paper to be submitted that focuses on the development of the ERCOT Test Systems

- * **M1 Modification (Ok'd by PNNL):** For M1 we have skipped the modeling of the old (zonal) ERCOT system and instead directly worked to develop an 8-bus model of the new (nodal) ERCOT system.
- ** **M3 Modification: Contract extension through December 31, 2018 received from PNNL on Oct 31, 2018, for completion of task M3**

ERCOT Work for Milestone M3.2: AMES Extensions

Extension of AMES V5.0 Capabilities for Milestone M3.2

- [DONE] ***Coding for Daily DAM SCUC optimization***
- [DONE] ***Coding for RTM SCED optimization every M minutes (M user specified).***
- [DONE] ***Coding for FNCS integration*** to enable network co-simulation.
- [DONE] ***Detailed documentation for analytical DAM SCUC/SCED optimization in AMES V5.0***
- [DONE] ***Basic documentation for AMES V5.0***, including a detailed list for all parameters/flags and initial state variables that need user configuration.
- **[IN PROGRESS: Swathi]** Verification checks for AMES V5.0 code
  - [Verification Tests Done]
    - Verified 'DAM SCUC' outcomes for their correctness for simple test cases
    - Verified 'RTM SCED ' outcomes for their correctness for simple test cases with *M =5*
    - Modified `PSST' code to read 'startup' and 'shutdown' cost components from AMES
    - AMES V5.0 runs for multiple days
  - [Verification Tests in Progress]
    - Additional DAM/RTM verification test cases are being formulated and conducted
    - Need to verify correct "refreshing" of initial DAM/RTM conditions for multiple-day runs
    - Need to ensure outcomes are reported properly back to the user.
- **[IN PROGRESS: LT]** Fuller documentation for AMES V5.0

Concerns: GLD Household ETP Model

REFERENCES:

[1] L. Tesfatsion and S. Battula (2018), "Notes on the GridLAB-D Household Equivalent Thermal Parameter Model," ISU Working Paper, November.
http://www2.econ.iastate.edu/tesfatsi/GLDETPHouseholdModel.Notes.LTesfatsionSBattula.pdf

[2] Pratt, R (2010) House-E Heating/Cooling Loads: Specifications and User Inputs, Pacific Northwest National Laboratory Report, Version 19.0 (12/23/2010).

[3] GridLAB-D, 2017. Residential Module User's Guide,
http://gridlab-d.shoutwiki.com/wiki/Residential_module_user's_guide

[4] GLD (2018) Explanation of the GLD `Aspect_ratio',
http://gridlab-d.shoutwiki.com/wiki/Aspect_ratio

[5] GLD code for House,
https://github.com/gridlab-d/gridlab-d/blob/master/residential/house_e.cpp

Concerns: GLD Household ETP Model … Continued

CONCERN 1: Ambiguity regarding definition of GLD aspect ratio R

- Observed a discrepancy between the definition of 'Aspect Ratio' (R) at GLD sites [3] and [4].
- Standard definition of aspect ratio: the ratio of the width to the height of an image or screen
- Reference [4] defines 'aspect_ratio' as the width-to-length ratio of a house's footprint.
- Reference [3] defines it as $R = y/x$, where *x = width, y = depth.*
- Is R = y/x or is R = x/y, where x and y are defined as x = width and y = depth in the Residential Module User's Guide [3]?

Concerns: GLD Household ETP Model … Continued

CONCERN 2: Possible glitch in the GLD coding up of A_w

- In Residential Module User's Documentation [3], the net exterior wall area A_w (ft^2) is defined as

(i) $$A\_w = [A\_\{wt\} - (A\_d + A\_g)] * EWR$$

- In GLD code [5], A_w is defined as follows (Line 1393 of the house_e.cpp):

(ii) net_exterior_wall_area =

exterior_wall_fraction * gross_wall_area - window_area - door_area;

- Using notation (i), expression (ii) reduces to

$$A\_w = EWR * A\_\{wt\} - A\_g - A\_d$$

which suggests that (ii) in the GLD code is missing square brackets [ ] to enclose the expression after the * sign.

Concerns: GLD Household ETP Model … Continued

CONCERN 3: Missing coefficient [1-f_{ac}] for Qh in the determination of Qa and missing parameterized term f_{ac} \cdot Qh altogether in the determination of Qm(t).

Following code snippet from 'house_e.cpp' [5] suggests that f_{ac} has been hard-wired to the value f_{ac} = 0 in the GLD code, despite f_{ac} being identified as a user-set parameter.

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```
Line 1807        Qi = total.heatgain - load.heatgain;

Line 1808        Qa = Qh + (1-mass_internal_gain_fraction)*Qi
                         + (1-  mass_solar_gain_fraction)*Qs;

Line 1809        Qm = mass_internal_gain_fraction*Qi
                        + mass_solar_gain_fraction*Qs;
```

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