

# Presentation

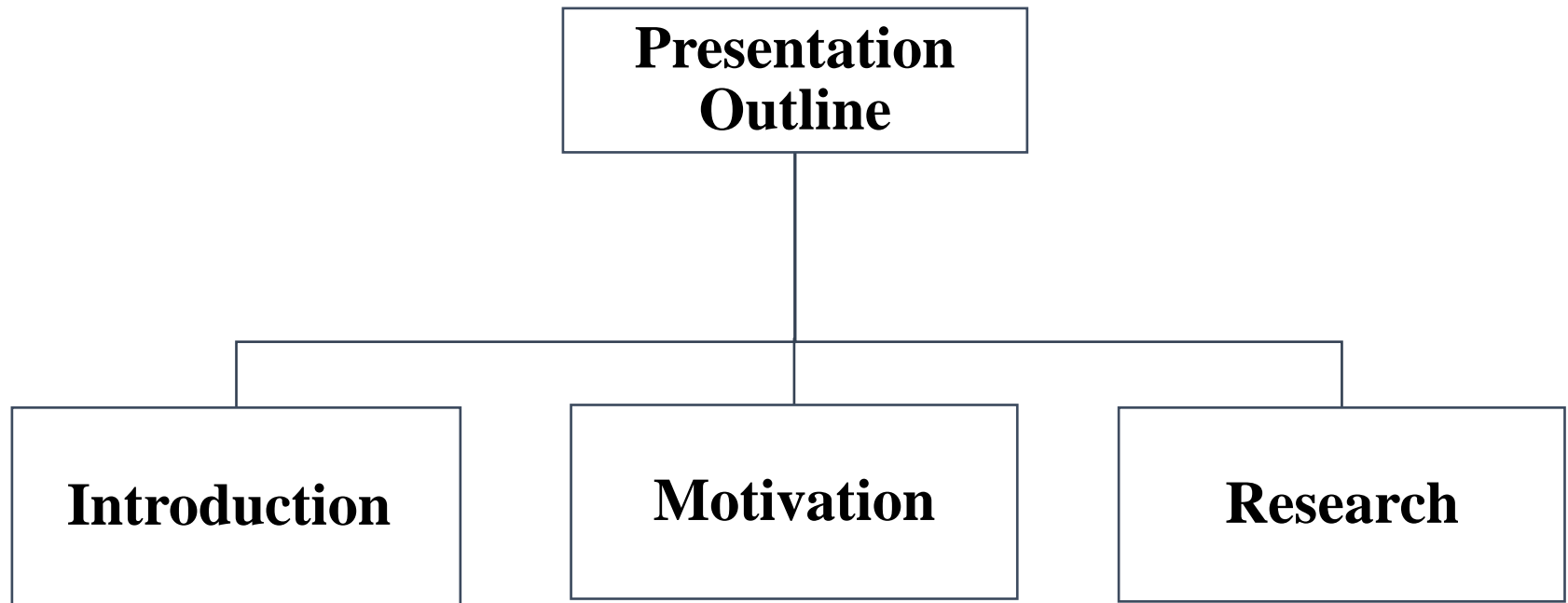
## Mohamed Abuella

[mabuella@cit.edu.ly](mailto:mabuella@cit.edu.ly)  
[mhdabuella@gmail.com](mailto:mhdabuella@gmail.com)



كلية التقنية الصناعية\_مصراته  
The College Of Industrial Technology\_Misurata





# Introduction

Mohamed Abuella

<https://mohamedabuella.github.io>

<https://www.linkedin.com/in/mohamed-abuella/>

## About Me..

An electrical engineer by training, traditionally is interested in Mathematical and Computational Analysis, Modeling and Optimization, and who is recently passionate in Artificial Intelligence and Data-driven Analytics.

A researcher works to modernize the electric grid and optimize its integration of distributed energy resources by applying descriptive, predictive and prescriptive analytics.

An adaptative to work in a diverse environment for an interdisciplinary research.

# Introduction

To sum it up in a broad sense, let's imagine that.. If my professional development was a book, its title would be **“Electric Power Systems Operation and Planning”**

*Thus, the chapters of this book would be as follows:*

**Ch.1** Fundamentals of Electrical Engineering. This chapter covers Instrumentation & Control, Basics of Power Electronics such as Diodes & Thyristors as rectifiers, (maneuvered by applying Laws of Physics). With getting hands-on electrical installation & wiring and maintenance of electrical control equipment at pumping stations.

**Ch.2** Power Systems Analysis. It includes Power Flow and Faults Calculations, (applying Numerical Analysis methods, such as Newton methods, Differential eqs & Integrals, etc). Get hands-on some simulations of power systems and programmable logic controllers (PLC).

**Ch.3** Optimal Power Flow (OPF) and Security-Constrained Economic Dispatch (SCED). It is considering renewables as well, specifically for wind energy resources at the transmission level, (applying Optimization techniques). Get hands-on more of modeling and analysis of power systems.

**Ch.4** Optimize the Integration of Renewables into the Grid. Solar Power Modeling and Forecasting, (applying Descriptive, Predictive and Prescriptive Analytics, AI and ML techniques). Get hands-on data-driven analytics and become more familiar with conducting & publishing research.

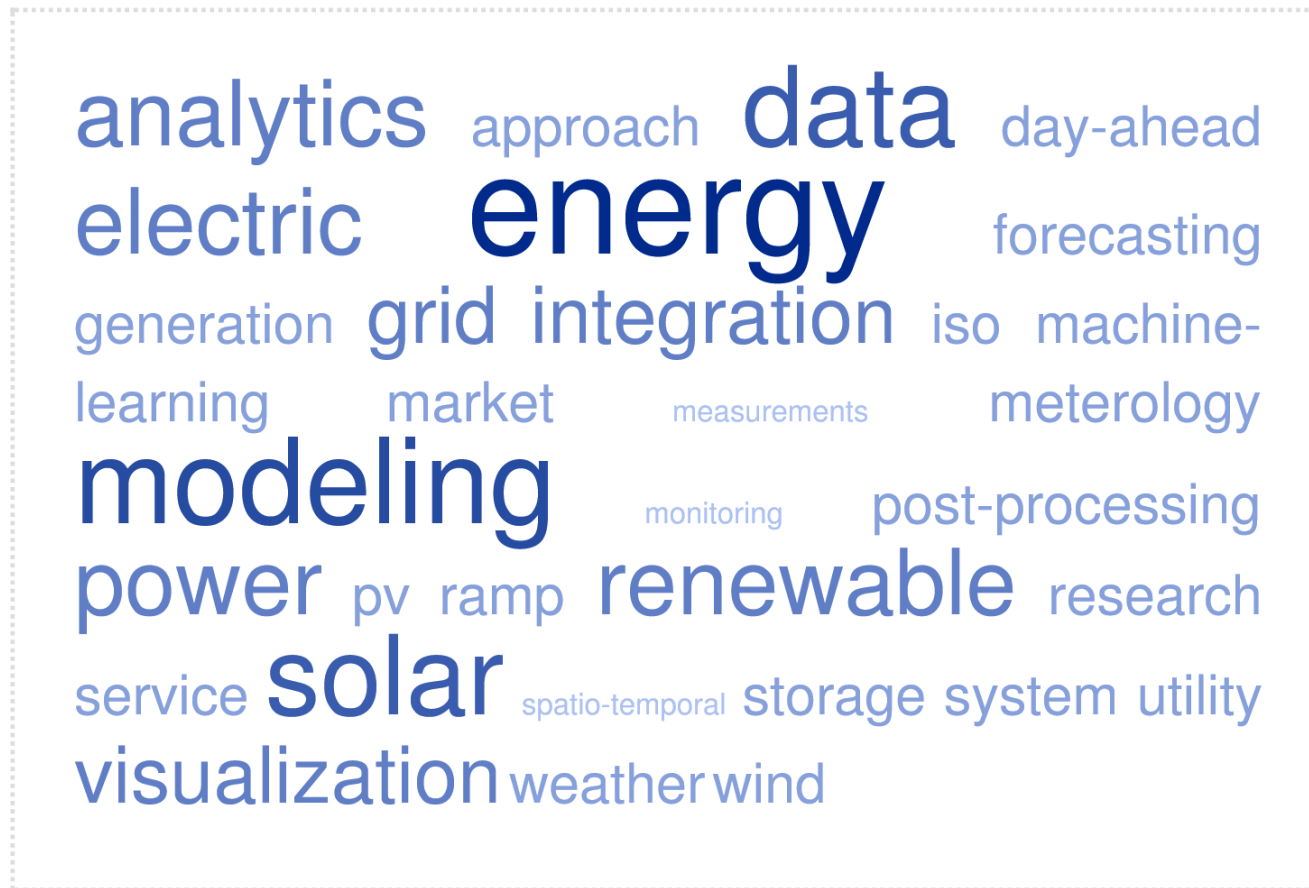
**Ch.5** Who knows!

# Introduction

In a nutshell, what I am often doing is finding the optimal & root values and curve fitting of nonlinear equations.

..But usually it is not as simple as that!

For more details, you may have a look at pdf copies of my [CV](#) and [Cloud of Key Skills & Interests](#).



# Motivation

- Professional Advancement
  - ✓ Get an opportunity to collaborate and work with the experts of the field.
  - ✓ To transfer, improve, and acquire knowledge and skills.
- Personal Advancement
  - ✓ Better alignment with personal values and interests.
  - ✓ Better self-esteem.
  - ✓ Better financial security.

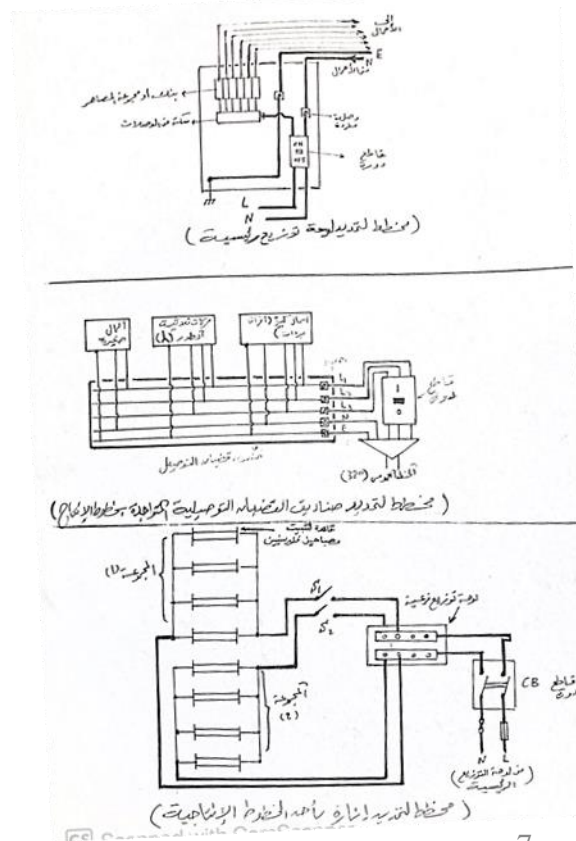
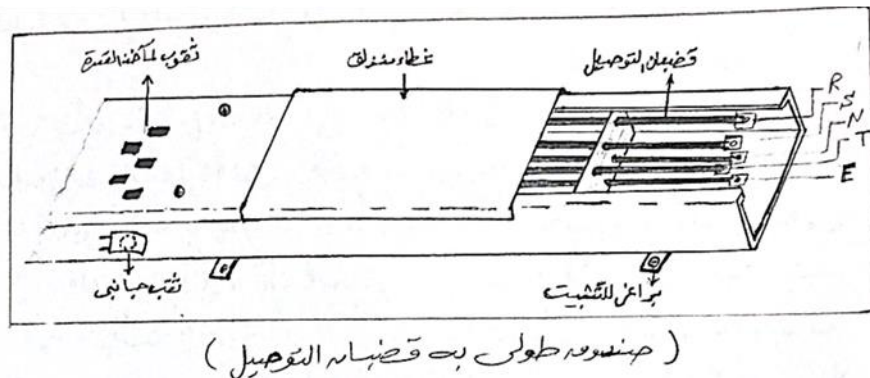
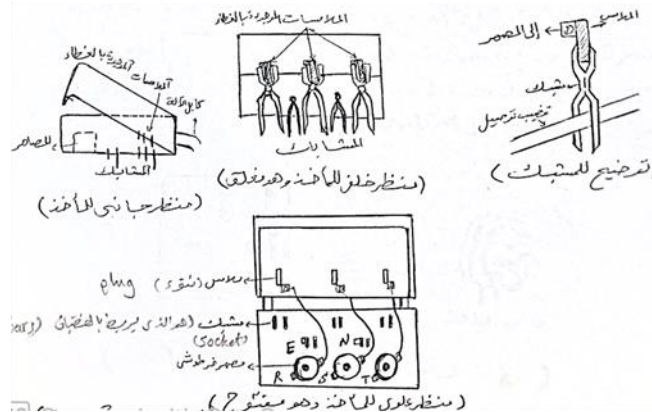
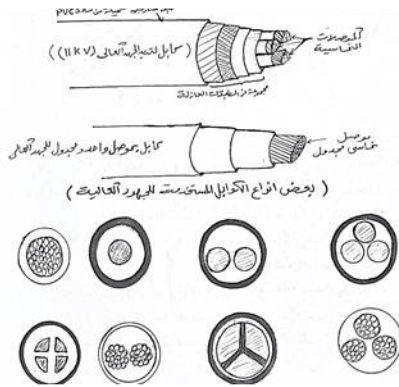
# Research

Technical Report of Operation & Maintenance, Internship at Shoes Factory in Misurata, Libya

[https://www.researchgate.net/publication/344772515\\_Technical\\_report\\_of\\_maintenance\\_and\\_operation\\_internship\\_at\\_shoes\\_factory\\_in\\_Misurata\\_Libya](https://www.researchgate.net/publication/344772515_Technical_report_of_maintenance_and_operation_internship_at_shoes_factory_in_Misurata_Libya)

Mohamed Abuella, 2000 at Higher Center of Poly-Profession, Misurata, Libya

Electrical Operation & Maintenance for fulfilling requirement of the Higher Diploma



# Research

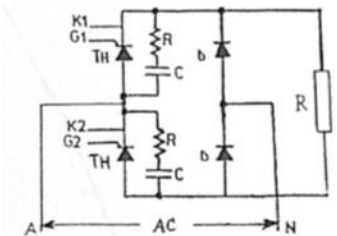
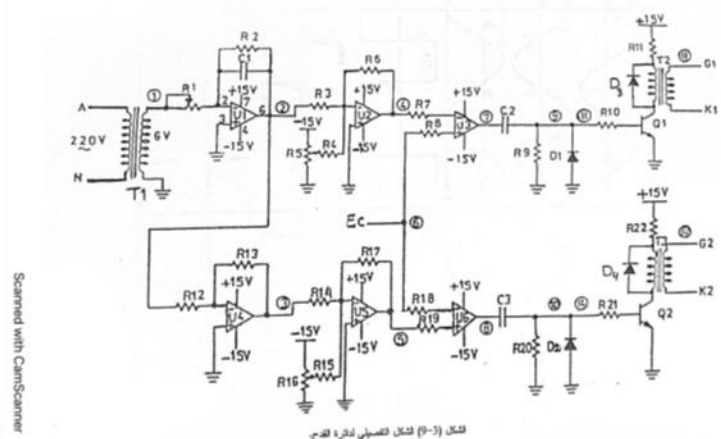
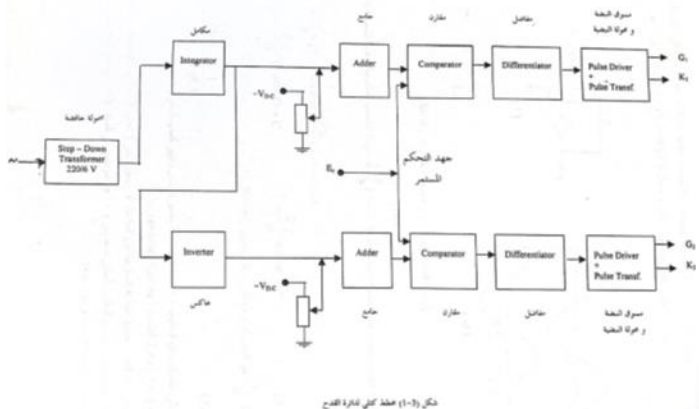
## Triggering Circuit for SCR Thyristors of an AC-DC Converter

[https://www.researchgate.net/publication/277109663\\_Triggering\\_Circuit\\_for\\_SCR\\_Thyristors\\_of\\_an\\_AC-DC\\_Converter](https://www.researchgate.net/publication/277109663_Triggering_Circuit_for_SCR_Thyristors_of_an_AC-DC_Converter)

Mohamed Abuella, Ali Mohamed, Al Sayed Hamady, Advisor: Safa Samarmad  
Tech Diploma Project, 2001 at Higher Center of Poly-Profession, Misurata, Libya

Higher Diploma project was in Power Electronics area. Since the task of the project of three-members-group was to build a triggering electronic circuit for a rectification bridge of Thyristors

**Acquired Expertise:** Electrical Wiring & Installations, Maintenance & Operation



Number: 30000  
Status: Production  
Package: TO-48 (14)  
Type: Discrete  
Material: DISCRETE  
Type: Discrete  
Support: datasheet  
Doc: SCR Phase Control (discrete)  
FOD # 30000



Parameter	Limit	Units	Condition	Value
VDRM	MIN	Volts	NA	1200
IT(RMS)	MAX	Amps	NA	35
IT(av) comp (a)	MAX	Amps	NA	22
@ TC	---	o C	NA	85
ITSM (50Hz)	MAX	Amps	NA	335
ITSM (60Hz)	MAX	Amps	NA	355
Vgt	Max	Volts	NA	2
Igt	Max	mAmps	NA	60
VTM comp (a)	MAX	Volts	NA	1.7
@ ITM comp (a)	---	Amps	NA	70
DV/dt	MAX	V/us	NA	300
RRn(JC)	MAX	o C/W	NA	85



# Research

## Study of NEPLAN Software for Power Flow and Short Faults Analysis

[https://www.researchgate.net/publication/277110587\\_Study\\_of\\_NEPLAN\\_Software\\_for\\_Load\\_Flow\\_and\\_Short\\_Faults\\_Analysis/stats](https://www.researchgate.net/publication/277110587_Study_of_NEPLAN_Software_for_Load_Flow_and_Short_Faults_Analysis/stats)

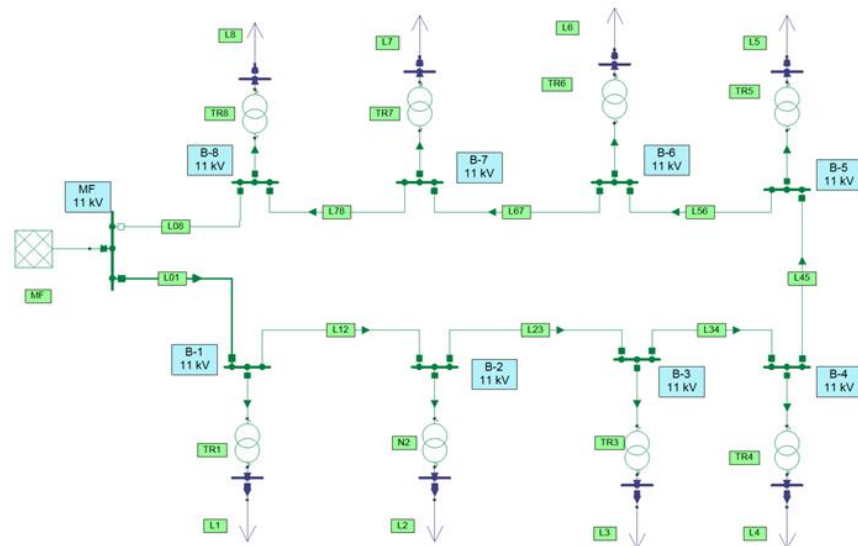


**NEPLAN**  
Smarter Tools

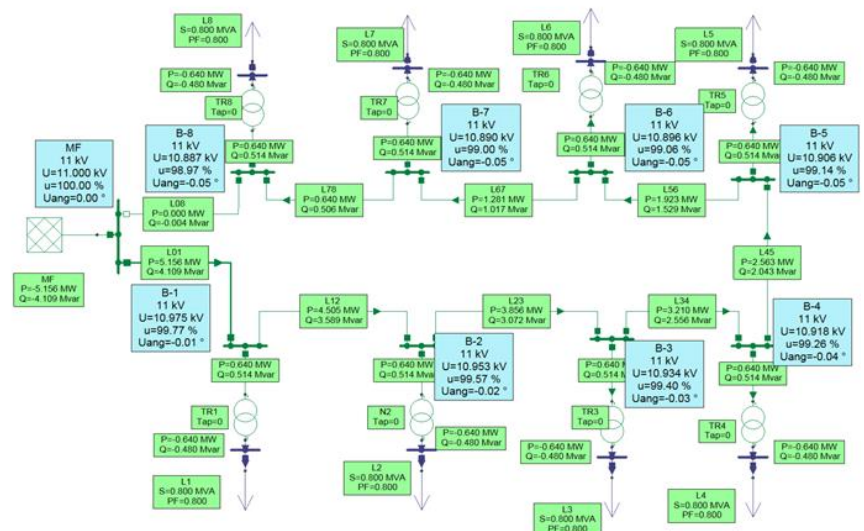
B.Tech Project, 2008 at College of Industrial Technology, Misurata, Libya  
Advisor: Mohamed Shetwan

**Acquired Expertise:** Teaching, Tutorials, Lab Modeling & Simulations, Curriculum Revision & Preparation, Dedication, Listening, "Try to Modeling the Student's Way of Thinking."  
Software Tools including: MS Office, MATLAB, NEPLAN, PLC's Ladder Logic

شبكة التوزيع الكهربائية (11/0.4 KV) للوحدات السكنية



• حساب سريان القدرة لشبكة التوزيع:



النتائج ظاهرة على مخطط شبكة التوزيع الكهربائية (11/0.4 KV) للوحدات السكنية

# Research



SMART GRID, Seminar

<https://www.slideshare.net/MohamedAbuella/smart-grid-37661484>

Smart Grid Presentation in Seminar Course, 2012 at Southern Illinois University at Carbondale

Study of particle swarm for optimal power flow in IEEE benchmark systems including wind power generators

<https://www.proquest.com/openview/21da3b4335a4c23278e9bd91d67a7784/1?pq-origsite=gscholar&cbl=18750>

Master of Science Thesis, 2012 at Southern Illinois University at Carbondale, USA

Advisor: Constantine Hatziadoniu

***Acquired Expertise:*** Power Systems Analysis, Operation and Planning, Systems Optimization, Smart Grid, Research Conducting, Software Tools: MATPOWER, PowerWorld, PSAT, LaTeX

# Research

Study of particle swarm for optimal power flow in IEEE benchmark systems including wind power generators

<https://www.proquest.com/openview/21da3b4335a4c23278e9bd91d67a7784/1?pq-origsite=gscholar&cbl=18750>



Master of Science Thesis, 2012 at Southern Illinois University at Carbondale, USA

Advisor: Constantine Hatziaodoniu

$$J_{Min} = \sum^M C_i(p_i) + \sum^N C_{wi}(w_i) + \sum^N C_{p,i}(w_i) + \sum^N C_{r,i}(w_i)$$

Subject to: **Where:**  $C_i = a_i P_i^2 + b_i P_i + c_i$

$$p_{i,min} \leq p_i \leq p_{i,max}$$

$$0 \leq w_i \leq w_{r,i}$$

$$\sum_i^M p_i + \sum_i^N w_i = L$$

$$V_i^{min} \leq V_i \leq V_i^{max}$$

$$S_{line,i} \leq S_{line,i}^{max}$$

$$C_{w,i} = d_i w_i$$

$$C_{p,i} = k_{p,i} \int_{w_i}^{w_{r,i}} (w - w_i) f_W(w) dw \text{ (underestimation)}$$

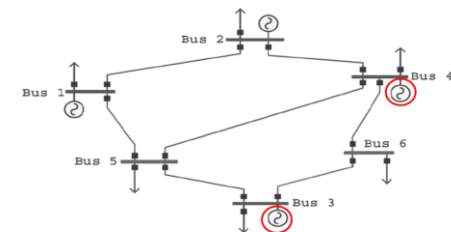
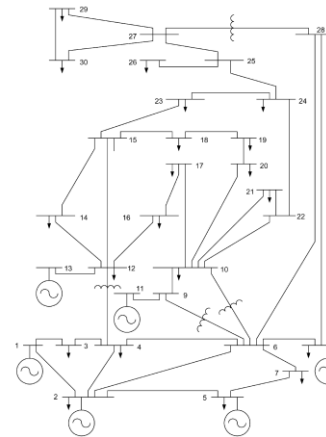
$$C_{r,i} = k_{r,i} \int_0^{w_i} (w_i - w) f_W(w) dw \text{ (overestimation)}$$



$$C_i = a_i P_i^2 + b_i P_i + c_i$$



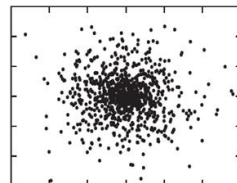
$$C_{w,i} = d_i w_i$$



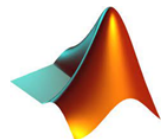
Gen. No.	a (\$/MW <sup>2</sup> ·hr)	b (\$/MW·hr)	c	P <sub>G, low</sub> (MW)	P <sub>G, high</sub> (MW)
1	0.012	12	105	50	250
2	0.0096	9.6	96	50	250
3	0	8	0	0	40
4	0	6	0	0	40



PSO



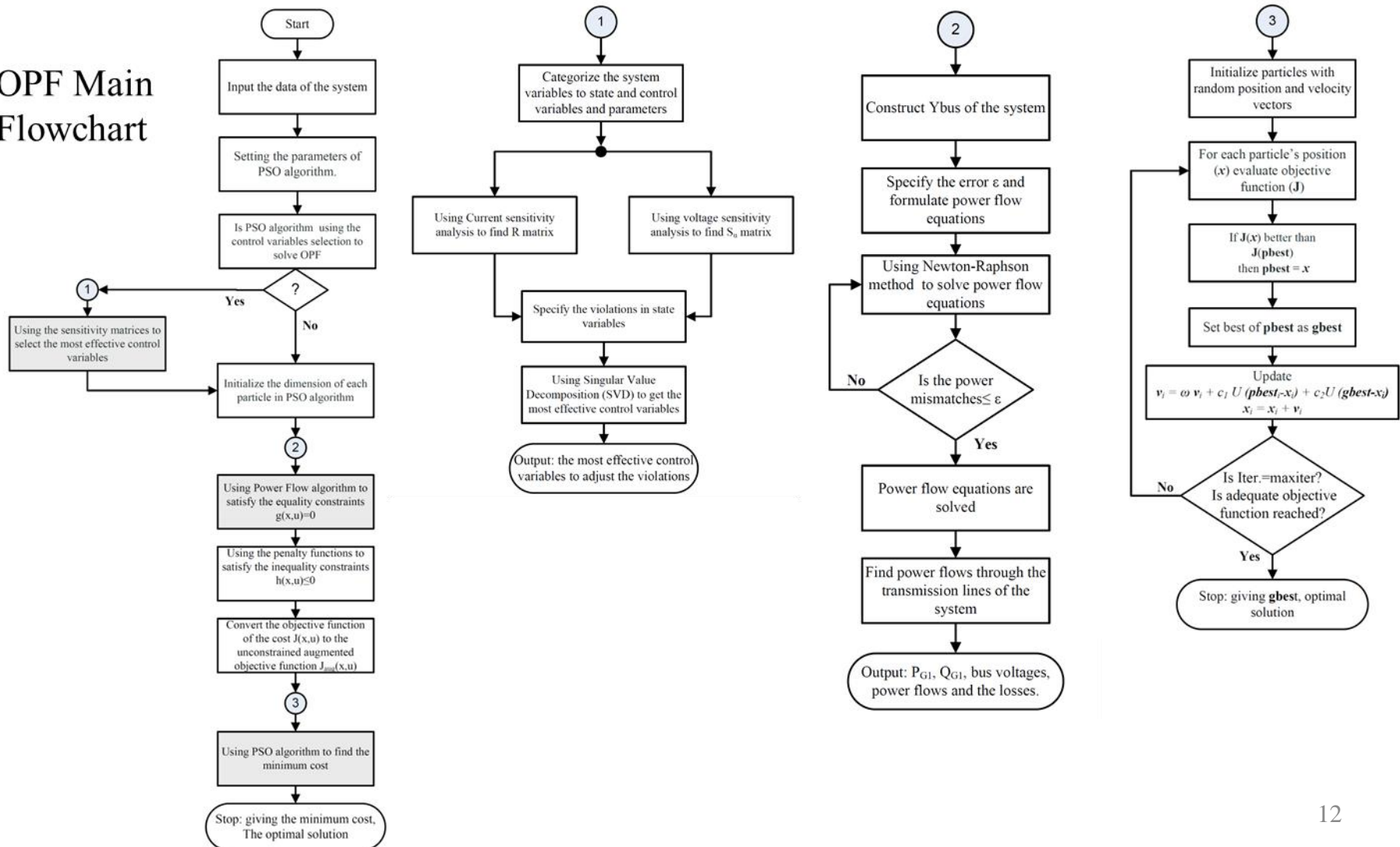
Particle Swarm Optimization (PSO) algorithm is used for solving this optimization problem.



# Research

Study of particle swarm for optimal power flow in IEEE benchmark systems including wind power generators

## OPF Main Flowchart



# Research

## A Post-Processing Approach for Solar Power Combined Forecasts of Ramp Events

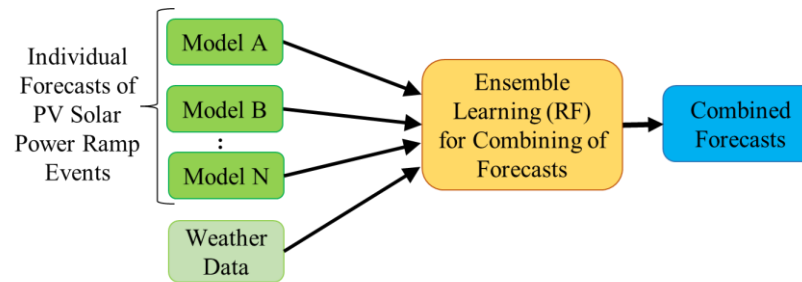
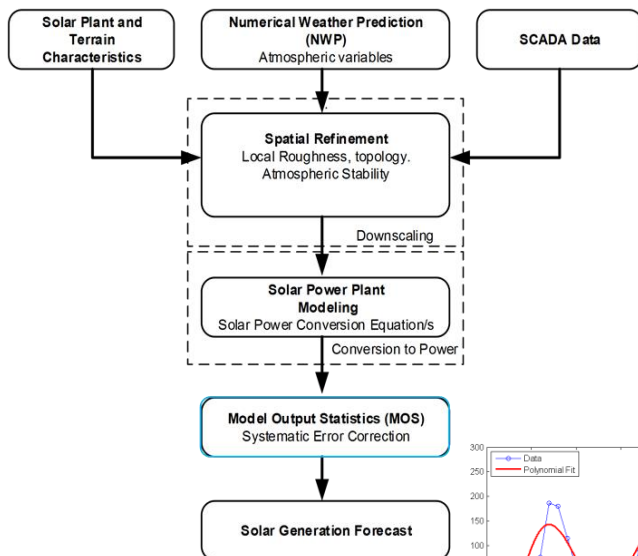
<https://www.proquest.com/openview/42049145119c7760f93ea736b37a0930/1.pdf?pq-origsite=gscholar&cbl=18750>

PhD Thesis, 2018 at University of North Carolina at Charlotte, USA

Advisor: Badrul Chowdhury



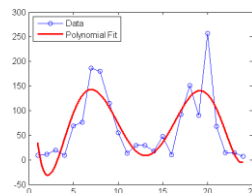
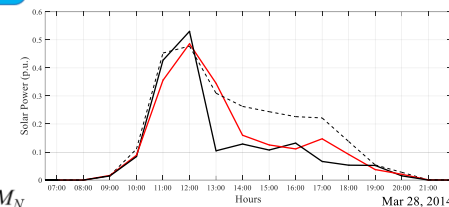
**Acquired Expertise:** Energy Analytics, Energy Markets, Renewable Energy Integration, Asset & Supply Chain, Time Series Analysis & Modeling, Risk & Uncertainty Quantification, Machine Learning, Big-Data Processing, Research Publishing & Peer Reviewing, Software Tools including SAS, R, and Python



General diagram of combining different models

$$F_{comb} = W_A * M_A + W_B * M_B + W_C * M_C + \dots + W_N * M_N$$

Method of Combining The Models → Random forest (RF) is chosen to be the *ensemble learning* method for combining the various models' outcomes.





## Why Forecast?

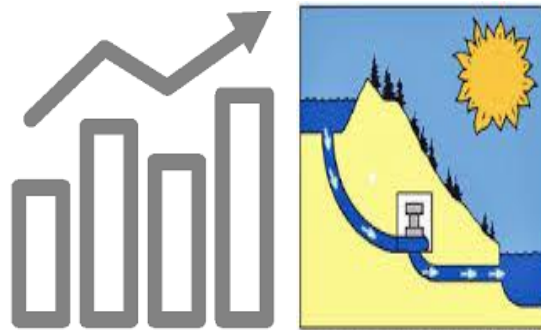
# Research

$$P_{\text{Supply}} = P_{\text{Demand}} + P_{\text{Loss}}$$

**PV Solar Power  
Generations  
are Too Variable**



**Coordination with Operating  
Reserves and Energy Storage  
Systems**



**Reducing  
Cost  
and Pollution**

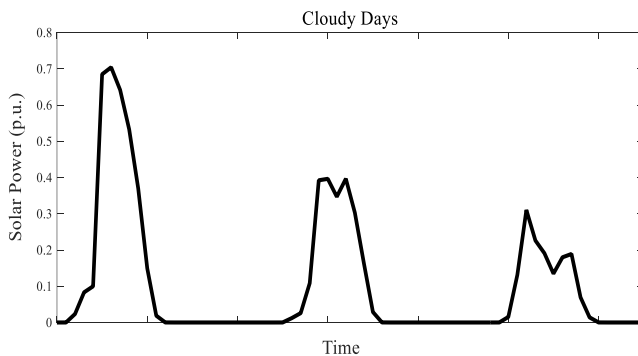


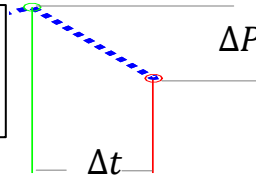
Illustration of the motivation of PV solar power forecasts

# Research

## Definition of Ramp Events

Solar power ramp rate (RR) is *the change of solar power during a certain time interval*.

$$\text{Ramp Rate, } RR(t) = \frac{dP(t)}{dt} = \frac{P(t + D) - P(t)}{D}$$



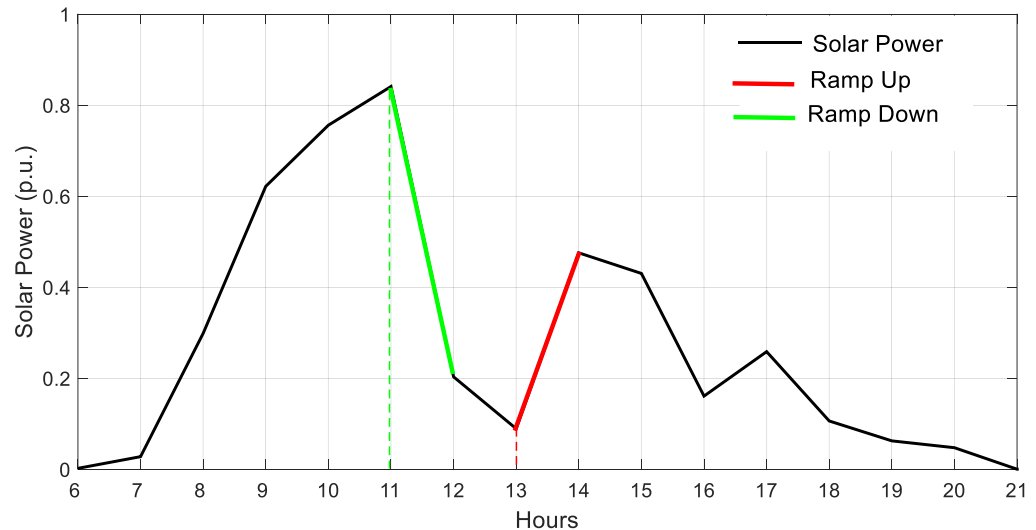
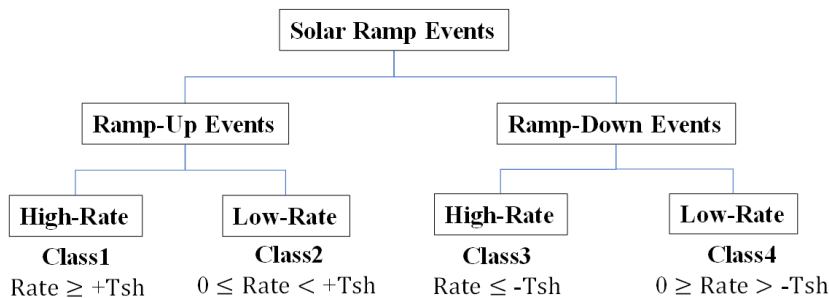
where  $P(t)$  is the solar power of the target hour, it can also be its forecast  $F(t)$ ;  $D$  is the time duration for which the ramp rate is determined.

For the illustrated cloudy day below:

**Ramp rate,**  $\frac{\Delta P}{\Delta t} = \frac{0.2 - 0.85}{12:00 - 11:00} = -0.65$  ( $-65\%$ ) ramp down of its normal capacity, (pu/hr)

**Ramp rate,**  $\frac{\Delta P}{\Delta t} = \frac{0.48 - 0.1}{14:00 - 13:00} = +0.38$  ( $+38\%$ ) ramp up of its normal capacity, (pu/hr)

Some ramps are with low rates, while others with high rates.



Distribution of the classes of solar power ramp events

Ramp Events During a Cloudy Day

# Research

## Potential Applications

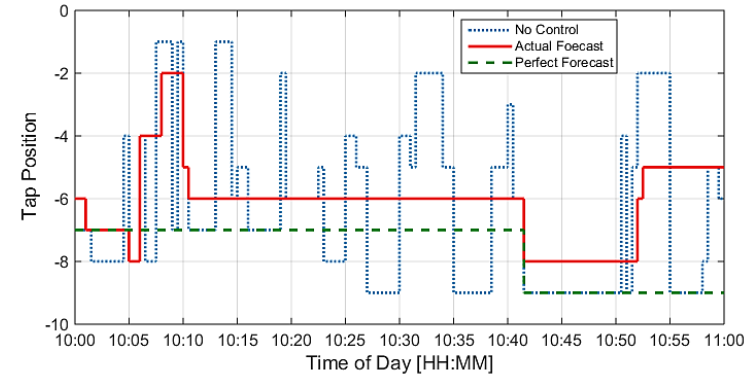
There are several applications of power systems that rely on solar power ramp event forecasts

Distribution level:

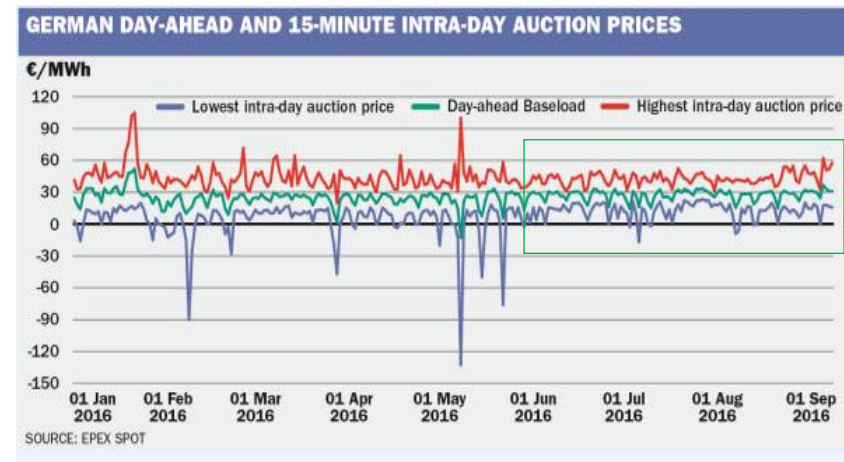
- Optimizing the voltage regulation equipment.
- Control schemes of energy storage systems.

Transmission / bulk level:

- Trading & dispatching the operating reserve.
- Managing the ramp capability / system flexibility with high-level of renewable energy integration.



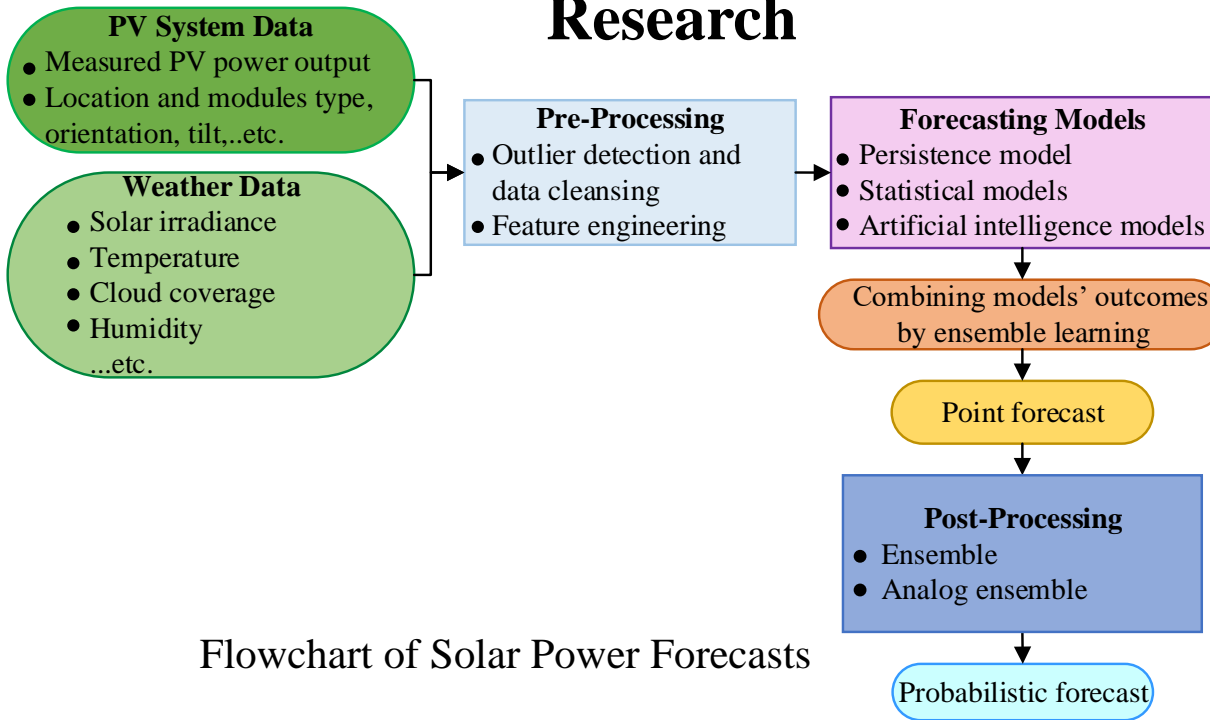
Optimizing the Transformer's Tap Changer position sequences using the solar forecast



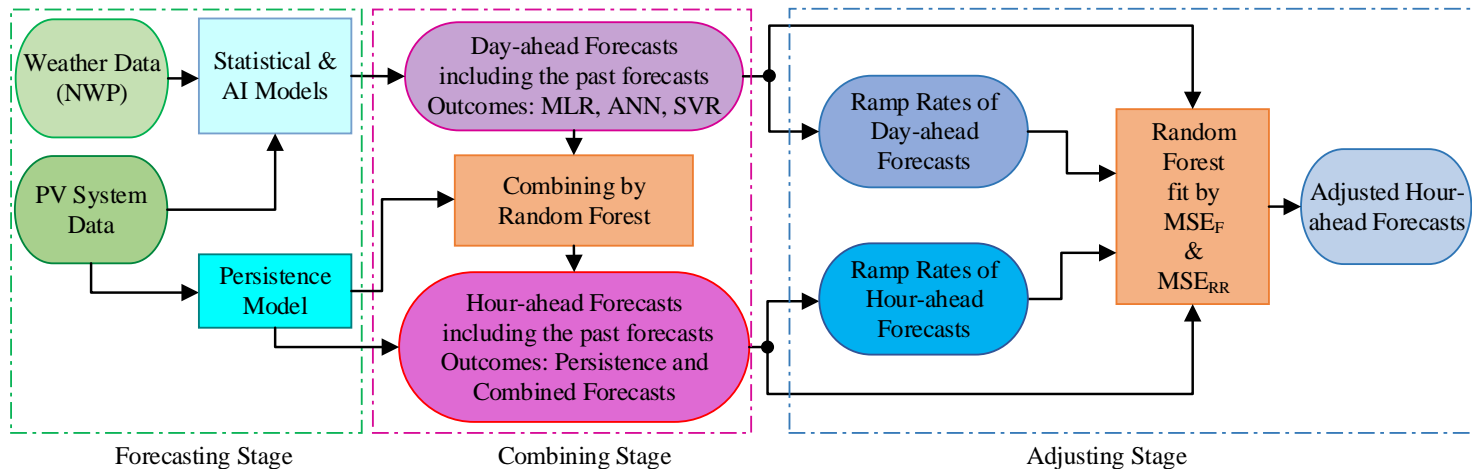
EPEX: European power exchange spot trading



# Research

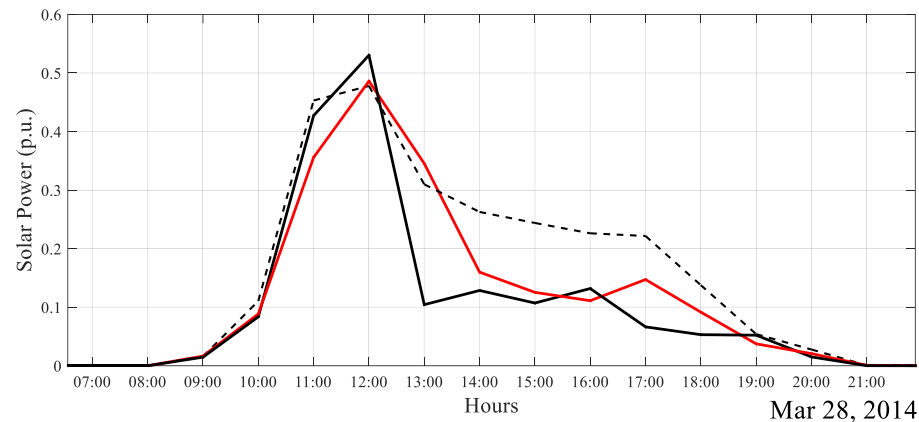
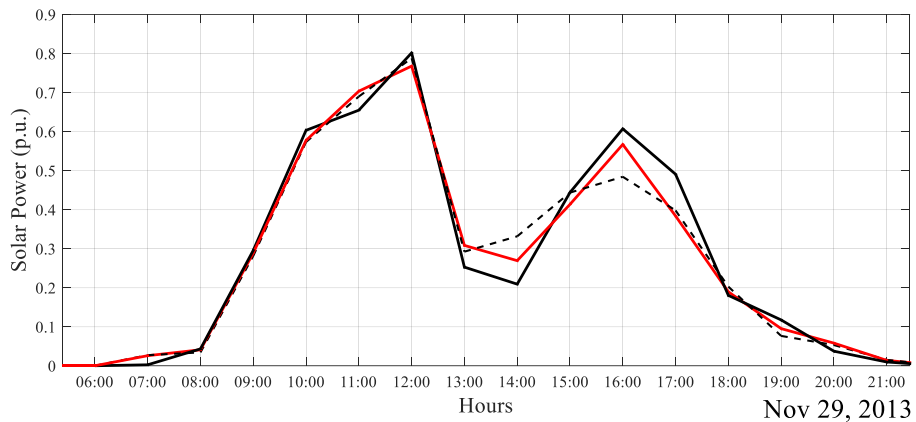
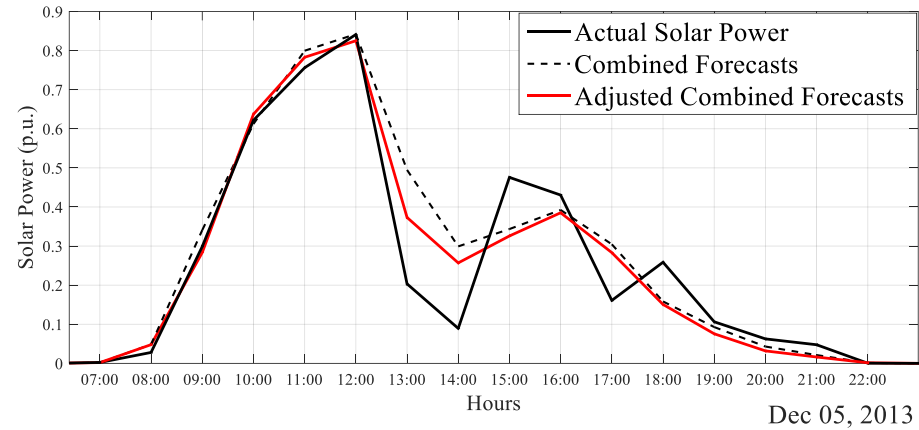
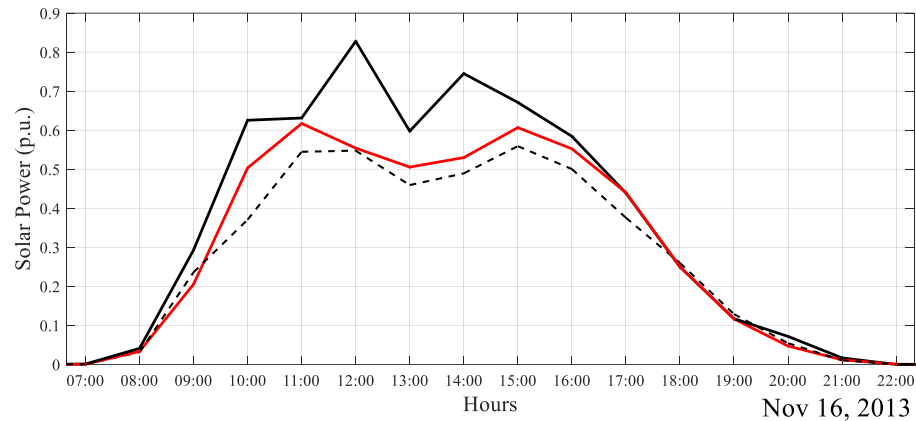


Flowchart of Solar Power Forecasts



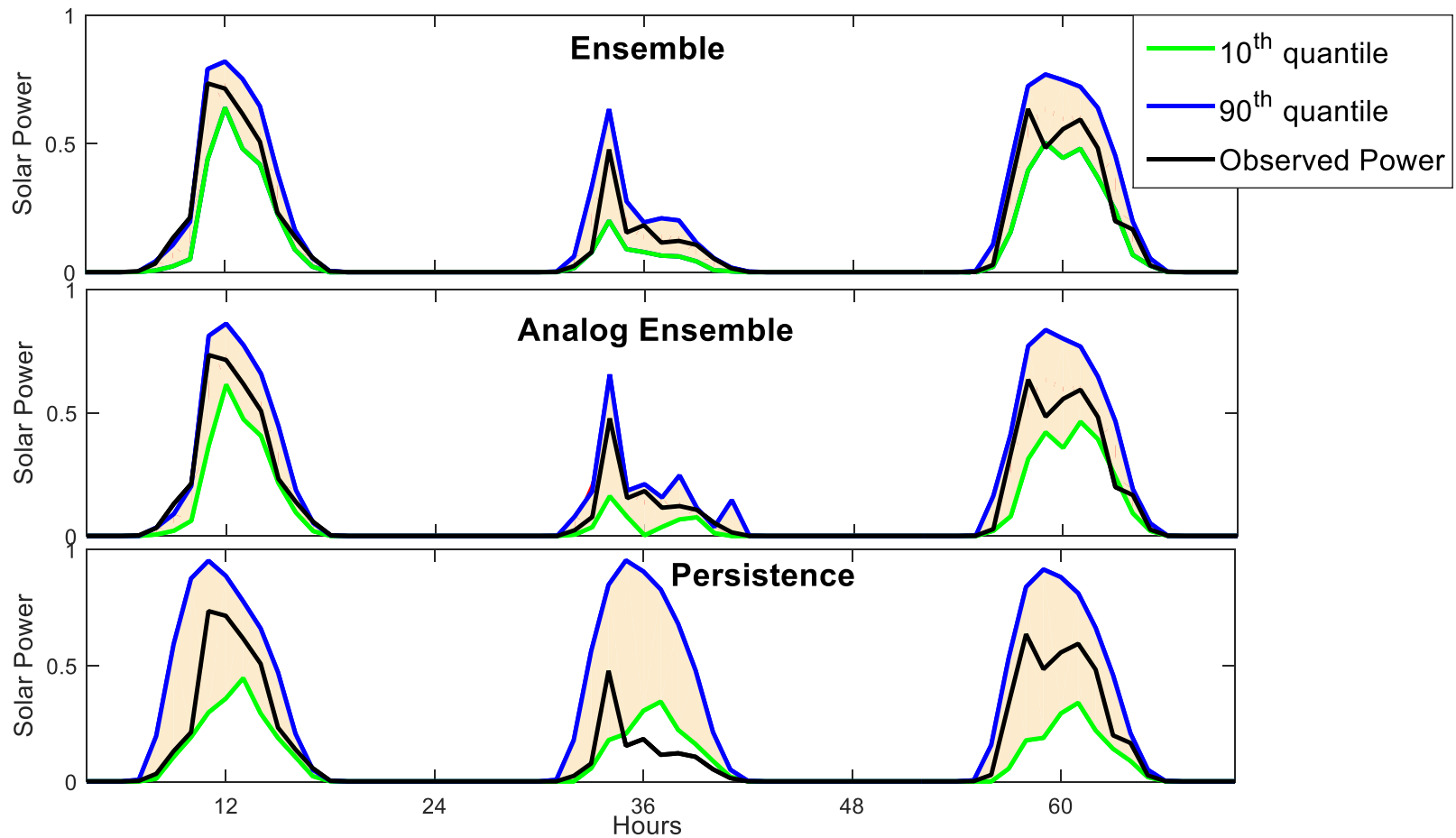
Block diagram of the adjusting approach

# Research



Combined forecasts of solar power for cloudy days before and after applying the adjusting

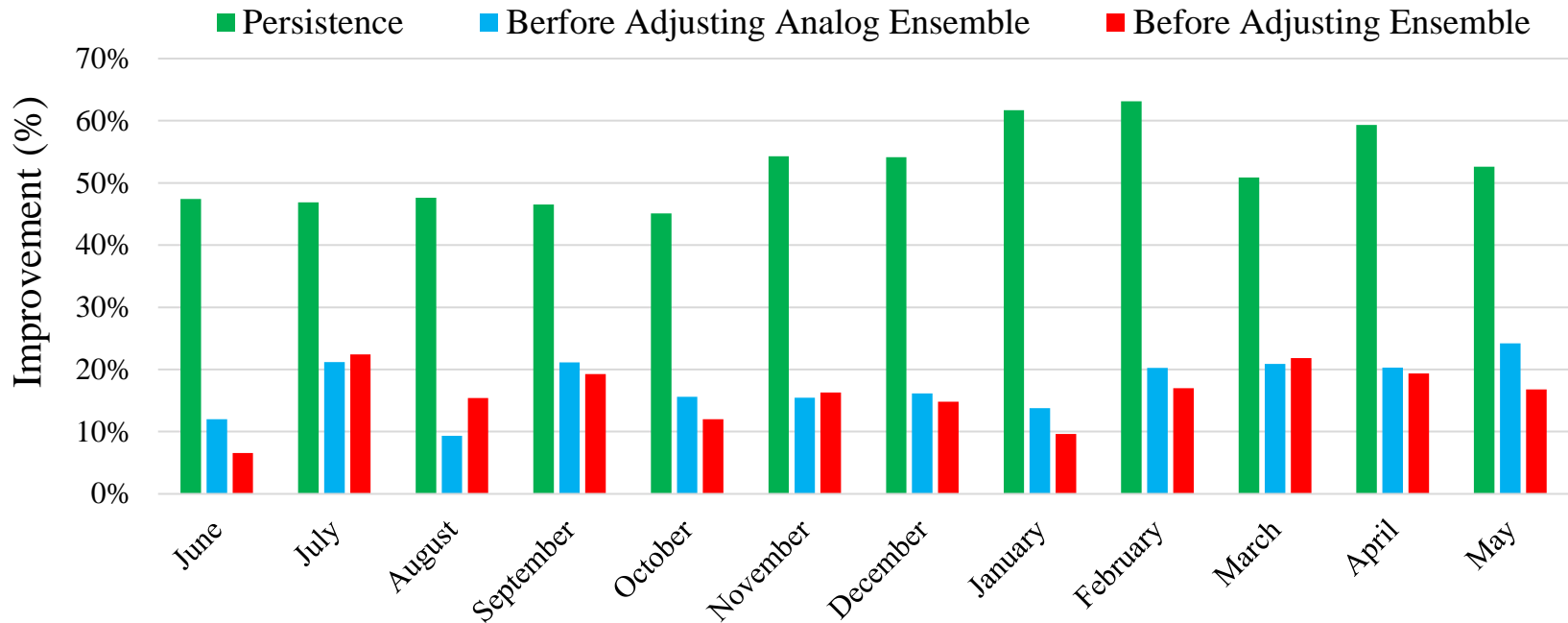
# Research



Graphs of the probabilistic forecasts of the three methods for three days

# Research

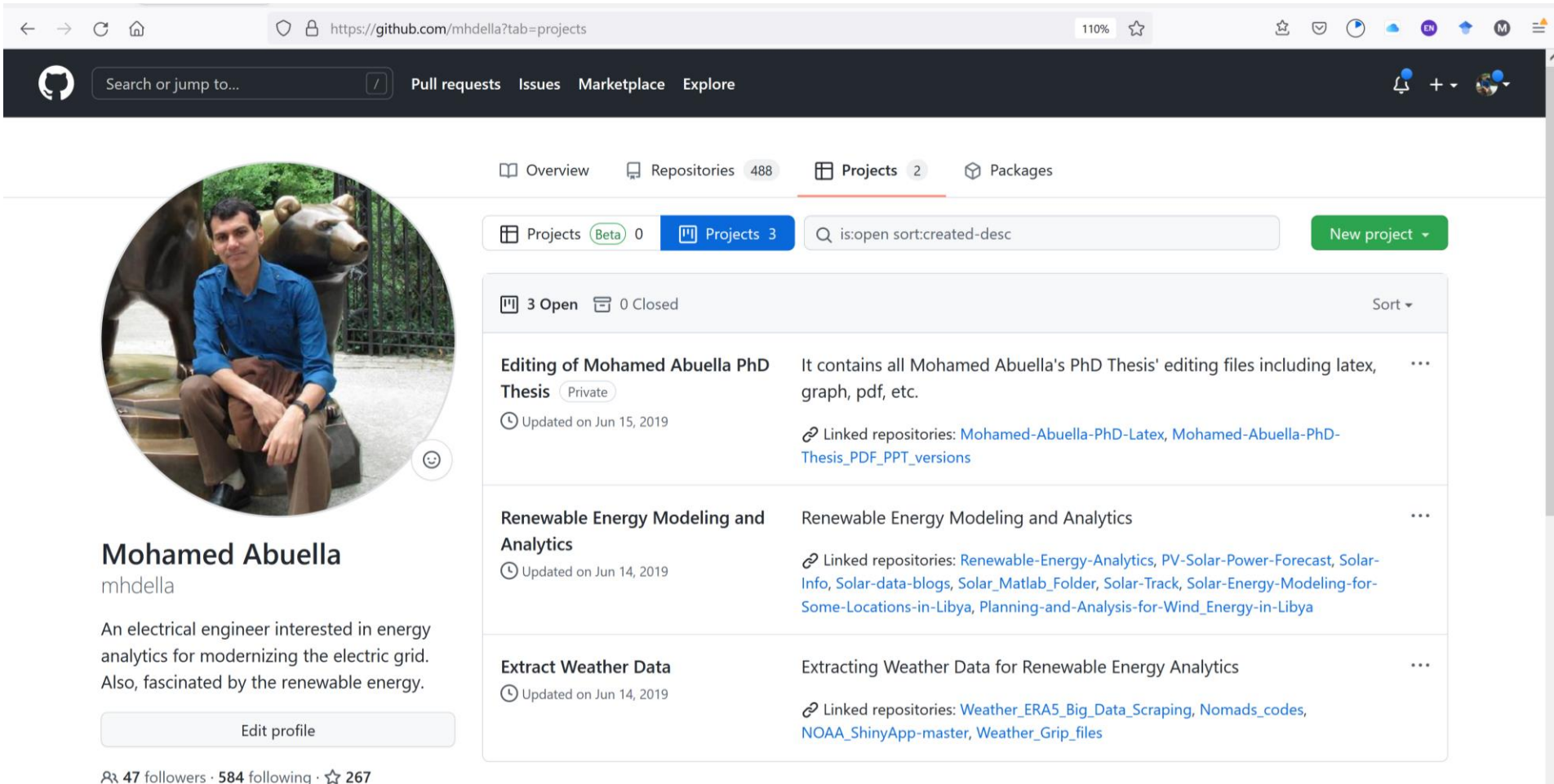
Improvement of Adjusted Ensemble-based Probabilistic Forecasts Over:



$$\text{Skill Score (\%)} = \left(1 - \frac{\text{Metric}_{\text{method}}}{\text{Metric}_{\text{reference}}}\right) * 100$$

# Research

Some other Projects in GitHub: <https://github.com/mhdella?tab=projects>



The screenshot shows the GitHub profile of Mohamed Abuella (mhdella). The profile includes a circular profile picture of a man sitting on a bench, a bio stating he is an electrical engineer interested in energy analytics, and statistics showing 47 followers, 584 following, and 267 repositories. The 'Projects' tab is selected, displaying a list of 3 open projects. The first project is 'Editing of Mohamed Abuella PhD Thesis' (Private), updated on Jun 15, 2019, containing LaTeX, graph, PDF, etc. files, with linked repositories 'Mohamed-Abuella-PhD-Latex' and 'Mohamed-Abuella-PhD-Thesis\_PDF\_PPT\_versions'. The second project is 'Renewable Energy Modeling and Analytics', updated on Jun 14, 2019, with linked repositories including 'Renewable-Energy-Analytics', 'PV-Solar-Power-Forecast', 'Solar-Info', 'Solar-data-blogs', 'Solar\_Matlab\_Folder', 'Solar-Track', 'Solar-Energy-Modeling-for-Some-Locations-in-Libya', and 'Planning-and-Analysis-for-Wind\_Energy-in-Libya'. The third project is 'Extract Weather Data', updated on Jun 14, 2019, for extracting weather data for renewable energy analytics, with linked repositories 'Weather\_ERA5\_Big\_Data\_Scraping', 'Nomads\_codes', 'NOAA\_ShinyApp-master', and 'Weather\_Grip\_files'.

https://github.com/mhdella?tab=projects

Search or jump to... Pull requests Issues Marketplace Explore

Overview Repositories 488 Projects 2 Packages

Projects (Beta) 0 Projects 3 is:open sort:created-desc New project

3 Open 0 Closed Sort

**Editing of Mohamed Abuella PhD Thesis** (Private) Updated on Jun 15, 2019

It contains all Mohamed Abuella's PhD Thesis' editing files including latex, graph, pdf, etc.

Linked repositories: [Mohamed-Abuella-PhD-Latex](#), [Mohamed-Abuella-PhD-Thesis\\_PDF\\_PPT\\_versions](#)

**Renewable Energy Modeling and Analytics** Updated on Jun 14, 2019

Renewable Energy Modeling and Analytics

Linked repositories: [Renewable-Energy-Analytics](#), [PV-Solar-Power-Forecast](#), [Solar-Info](#), [Solar-data-blogs](#), [Solar\\_Matlab\\_Folder](#), [Solar-Track](#), [Solar-Energy-Modeling-for-Some-Locations-in-Libya](#), [Planning-and-Analysis-for-Wind\\_Energy-in-Libya](#)

**Extract Weather Data** Updated on Jun 14, 2019

Extracting Weather Data for Renewable Energy Analytics

Linked repositories: [Weather\\_ERA5\\_Big\\_Data\\_Scraping](#), [Nomads\\_codes](#), [NOAA\\_ShinyApp-master](#), [Weather\\_Grip\\_files](#)

**Mohamed Abuella**  
mhdella

An electrical engineer interested in energy analytics for modernizing the electric grid. Also, fascinated by the renewable energy.

Edit profile

47 followers · 584 following · 267

# Research

Keep up some blogs on : <https://mohamedabuella.github.io/blog/>

## Blogs

- 01 Sep 2021 » [Blog Planning and Analysis for Wind Energy in Libya](#)
- 19 Jul 2021 » [Blog Planning and Analysis for Solar Energy in Libya](#)
- 11 Dec 2019 » [Blog Reading and Reflection on a Book of Solar Energy](#)
- 19 Aug 2019 » [Blog Does the Educational Curricula Keep the Pace with the Advancements in Energy Technologies?](#)
- 09 Aug 2019 » [Blog Wind and Solar Energy Resources Modeling and Analysis](#)
- 30 Jul 2019 » [Blog Net Load Forecasting for Microgrid Resiliency](#)
- 29 Jul 2019 » [Blog How a Subtle Lack of Knowledge Could Lead to Catastrophic Consequences](#)
- 23 Jun 2019 » [Blog Reading a Big-picture Book after a While of Focusing on Elaborate Technical Stuff](#)
- 17 Jun 2019 » [website Website Launched](#)

# Research

- Power System Flexibility and DG resources management, I have been working on Forecasting and Machine Learning approaches, since 2014
- Techno-economic analysis of HOMER (Report), C:\+HP Folders\+Folder2021\+Homer ProExs and examples of using NREL SAM, C:\Users\Mhdella\Desktop\Exs\_SAM
- Writing using Latex (Eqs, Biblio.), Mendeley (>5500 docs, tags), Evernote (organize notes, share them), Dropbox, Google Drive (clouds to back up), iCalendar, etc.
- Research Outreach and Knowledge Dissemination: depending extensively on the online tools, such as Blogs on personal website, LinkedIn, Twitter, Researchgate, Newsletter from relevant groups of interest (ESIG, AI in Smart Grids, ISES, WEMC, etc.)
- Review of IEEE Transactions on Sustainable Energy

The screenshot displays the ScholarOne Manuscripts web interface. At the top, the user is logged in as 'Mohamed Abuella'. The main header features the IEEE logo and the journal title 'IEEE Transactions on Sustainable Energy'. A navigation bar includes links for Home, Author, and Review. Below this, a sidebar on the left lists options: Reviewer View Manuscripts, Review and Score, Scores Submitted, Receive Recognition on Publons, Invitations, and Legacy Instructions. The main content area shows a green success message: 'Success! Your review has been submitted.' Below this, the section 'Scores Submitted' is visible, showing '1 - 10 of 33' items. A table lists the submission details:

ACTION	COMPLETED	ID/TITLE	STATUS
Select...	05-May-2020	TSTE-00996-2019.R2	Under Review

# Thanks for Your Listening

## Any Question?

Mohamed Ali Abuella  
[mabuella@cit.edu.ly](mailto:mabuella@cit.edu.ly)  
[mhdabuella@gmail.com](mailto:mhdabuella@gmail.com)



كلية التقنية الصناعية - مصراته  
The College Of Industrial Technology\_Misurata



  
UNC CHARLOTTE  
Energy Production and Infrastructure Center (EPIC)