

Presentation

Mohamed Abuella

mabuella@cit.edu.ly
mhdabuella@gmail.com



كلية التقنية الصناعية_مصراته
The College Of Industrial Technology_Misurata



Presentation Outline

```
graph TD; A[Presentation Outline] --> B[Introduction]; A --> C[Motivation]; A --> D[Research];
```

Introduction

Motivation

Research

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.

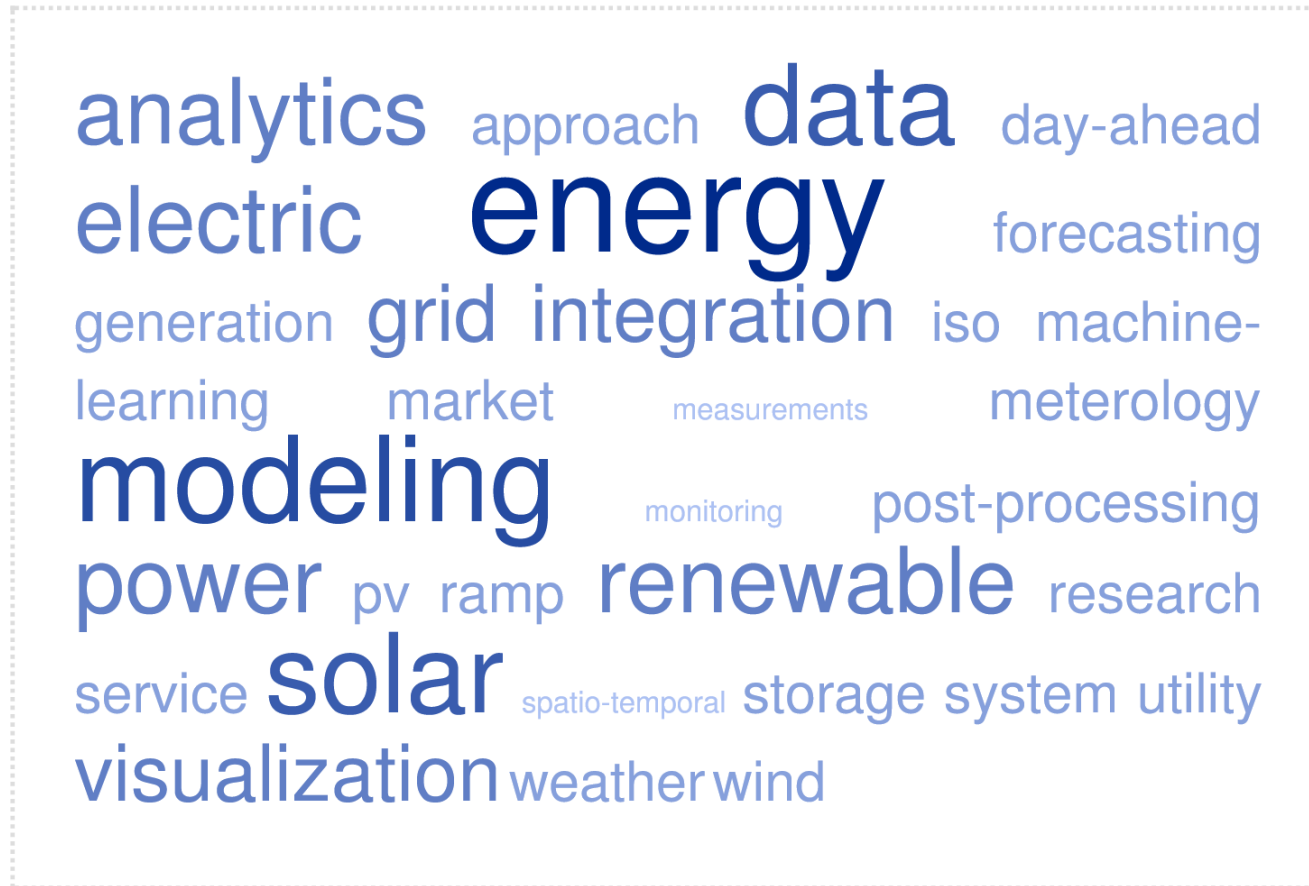
Ch.5 Who knows!

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.

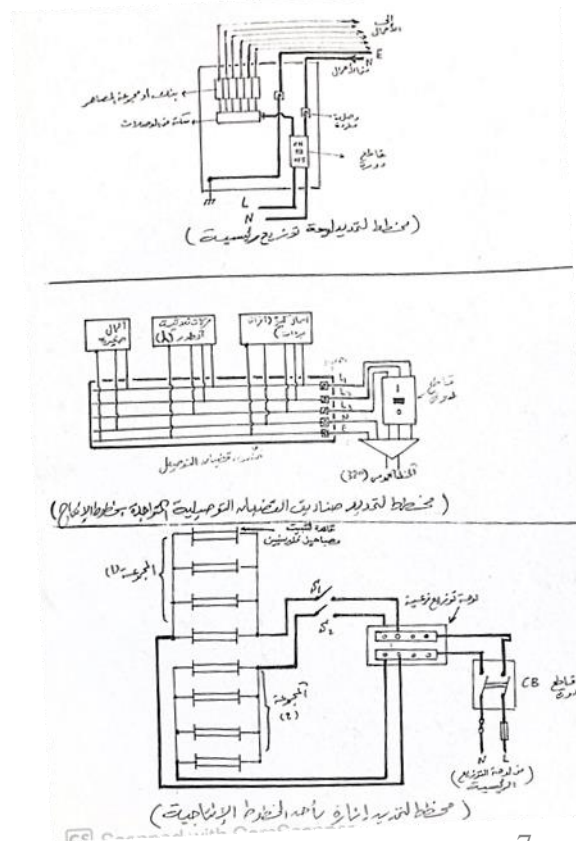
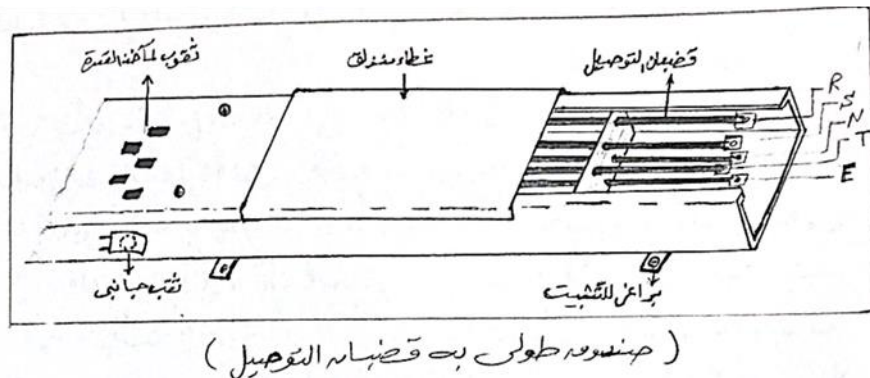
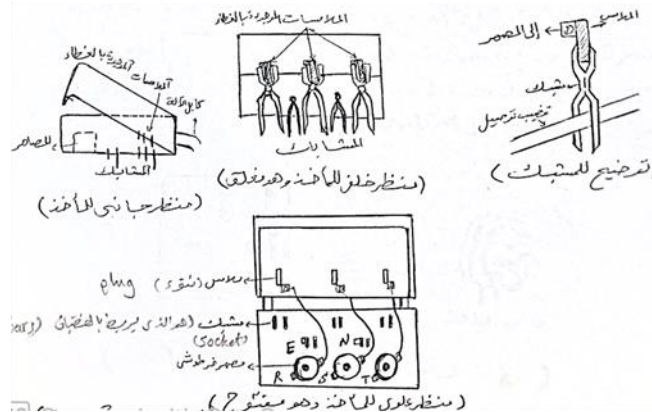
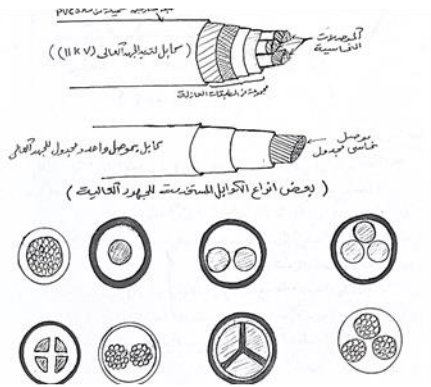
Research

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

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

Electrical Operation & Maintenance for fulfilling requirement of the Higher Diploma



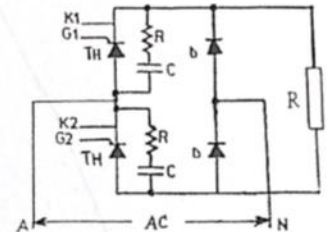
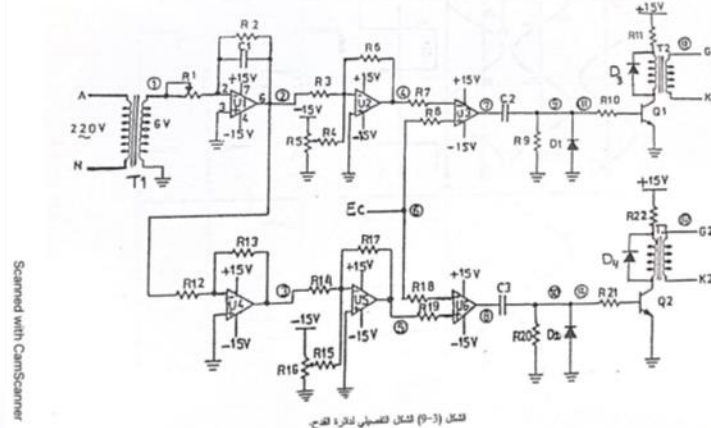
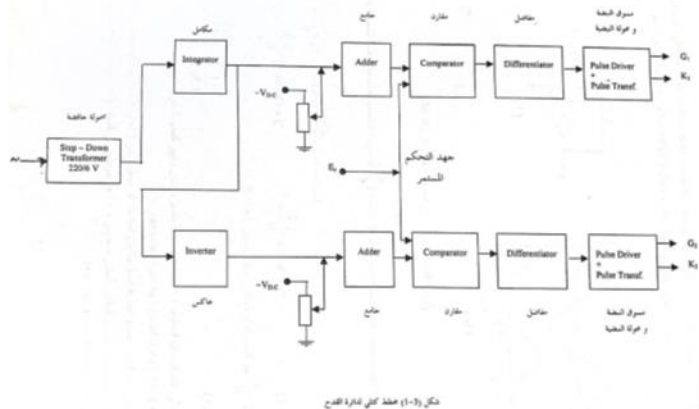
Research

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

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



Number: 30000
Status: Production
Package: TO-48 (14)
Type: DISCRETE
Circuit: SCR Phase Control Line (discrete)
FOD # 30000



TO 48

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	—	°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
DNIGT	MAX	V/μs	NA	300
RRH(JC)	MAX	°C/W	NA	80

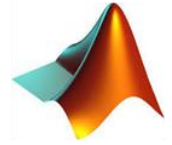
Research

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

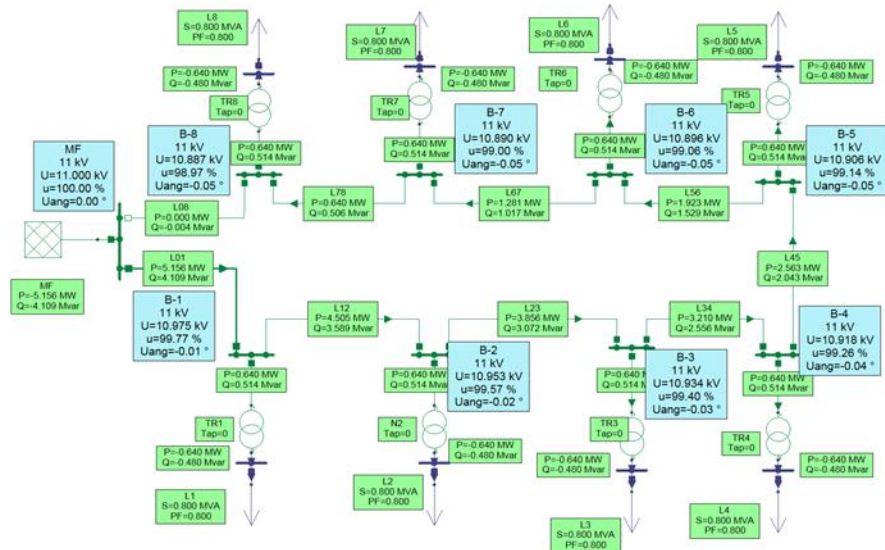
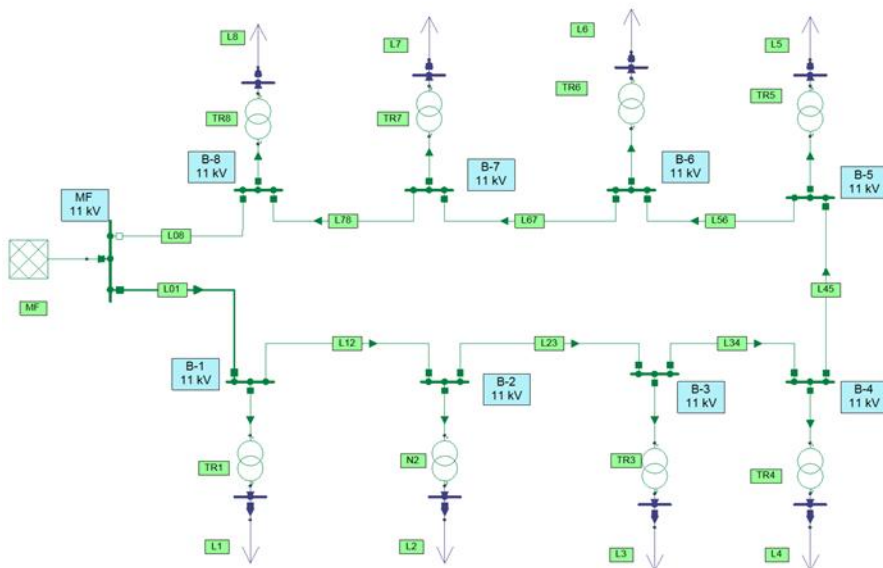
B.Tech Project, 2008 at College of Industrial Technology, Misurata, Libya

Advisor: Mohamed Shetwan



حساب سريان القدرة لشبكة التوزيع:

شبكة التوزيع الكهربائية (11/0.4 KV) للوحدات السكنية



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

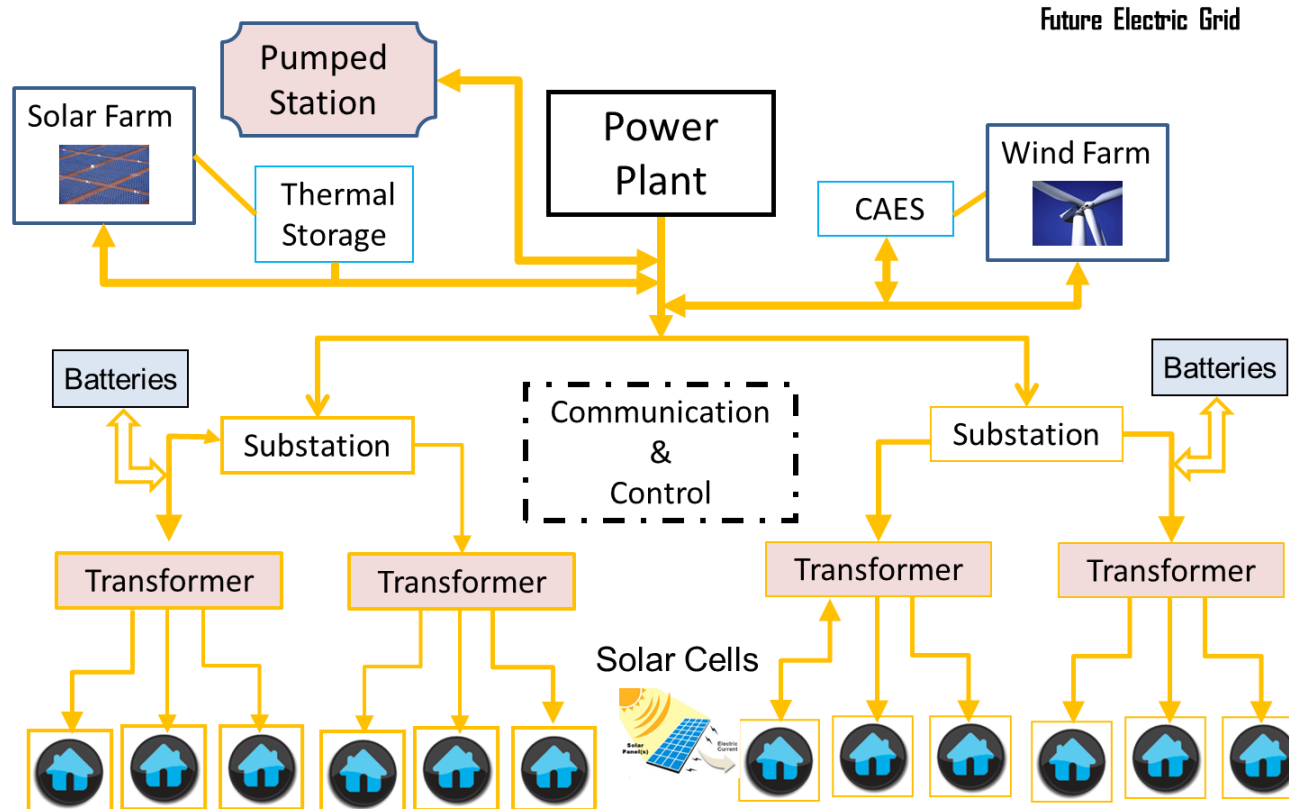
Research

SMART GRID, Seminar

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



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



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

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

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

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

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

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

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

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

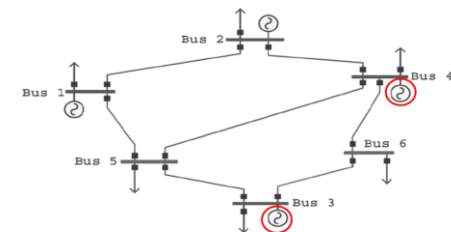
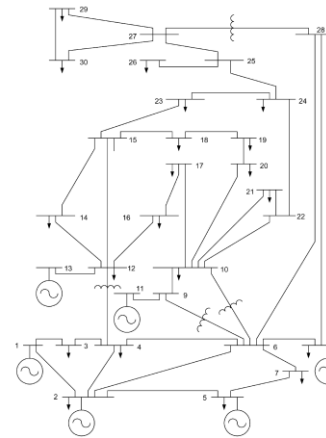
$$C_{r,i} = k_{r,i} \int_0^{w_i} (w_i - w) f_W(w) dw \text{ (overestimation)}$$



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



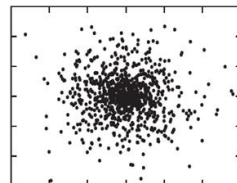
$$C_{w,i} = d_i w_i$$



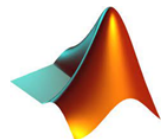
Gen. No.	a (\$/MW ² ·hr)	b (\$/MW·hr)	c	P _{G, low} (MW)	P _{G, high} (MW)
1	0.012	12	105	50	250
2	0.0096	9.6	96	50	250
3	0	8	0	0	40
4	0	6	0	0	40



PSO



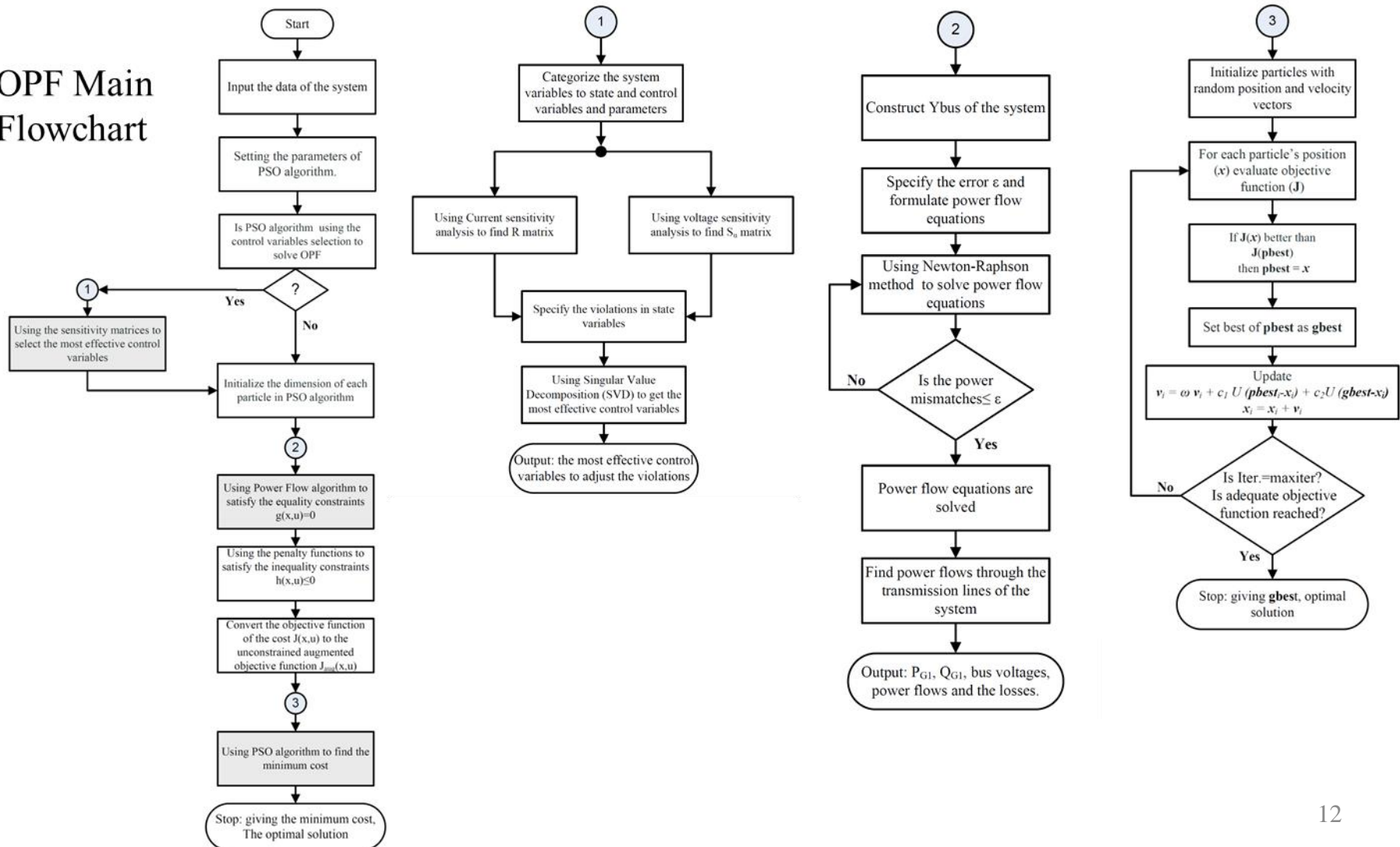
Particle Swarm Optimization (PSO) algorithm is used for solving this optimization problem.



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

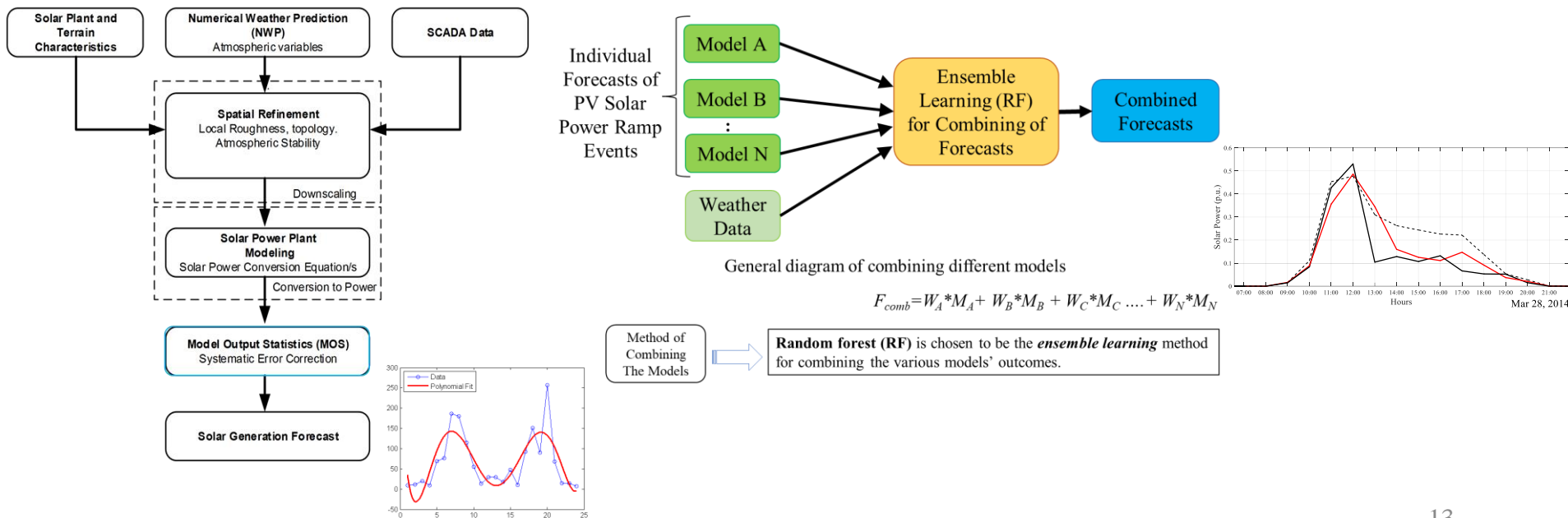
<https://www.proquest.com/openview/42049145119c7760f93ea736b37a0930/1.pdf?pq-origsite=gscholar&cbl=18750>

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

Advisor: Badrul Chowdhury



Combining of different forecasts can reduce the systemic bias of the individual models, boost the overall accuracy, and make the performance more robust, *but it also smooths out the sharp changes in forecasts*, which reduces the accuracy of the combined forecasts for ramp events.



Why Forecast?

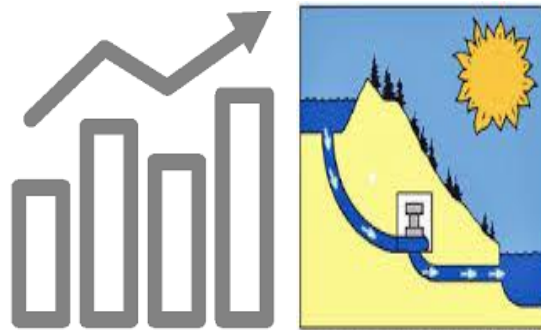
Research

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

**PV Solar Power
Generations
are Too Variable**



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



**Reducing
Cost
and Pollution**

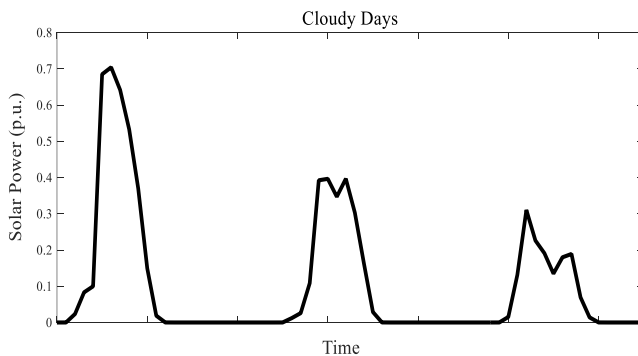


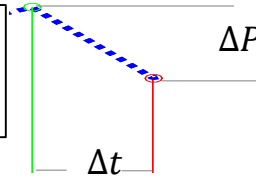
Illustration of the motivation of PV solar power forecasts

Research

Definition of Ramp Events

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

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



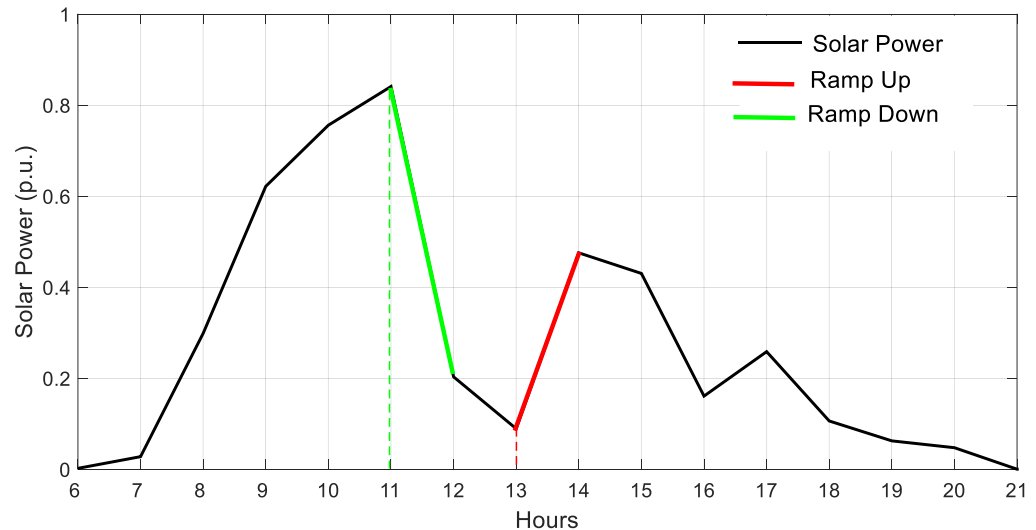
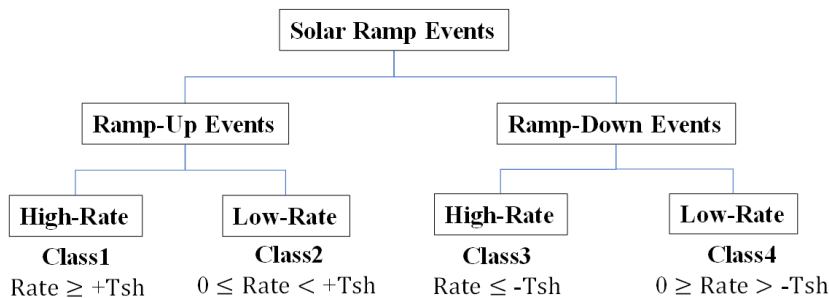
where $P(t)$ is the solar power of the target hour, it can also be its forecast $F(t)$; D is the time duration for which the ramp rate is determined.

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

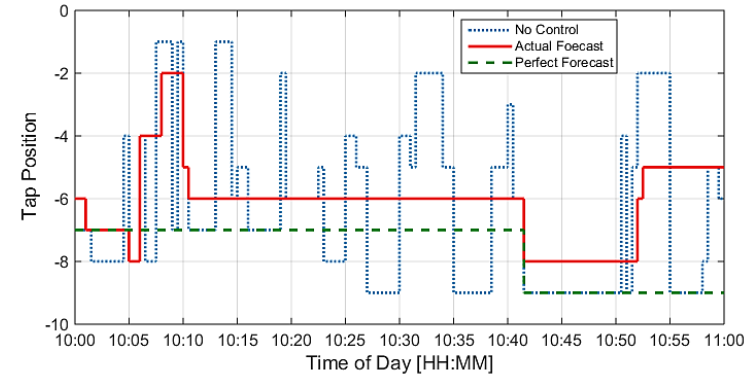
There are several applications of power systems that rely on solar power ramp event forecasts

Distribution level:

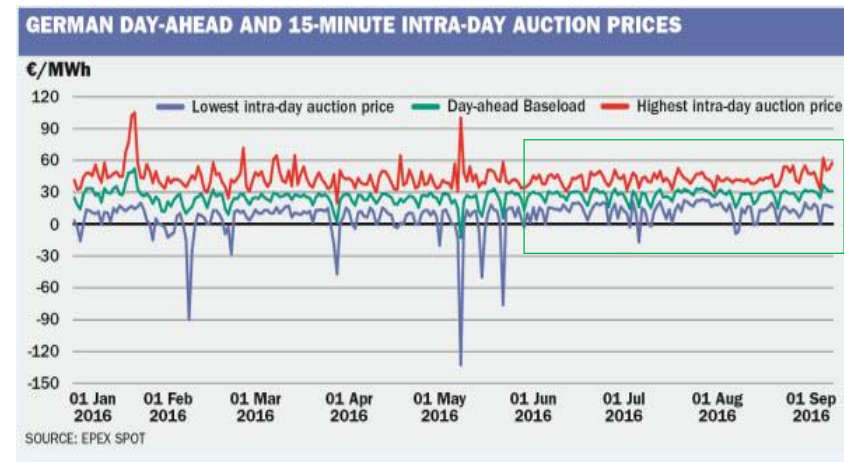
- Optimizing the voltage regulation equipment.
- Control schemes of energy storage systems.

Transmission / bulk level:

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

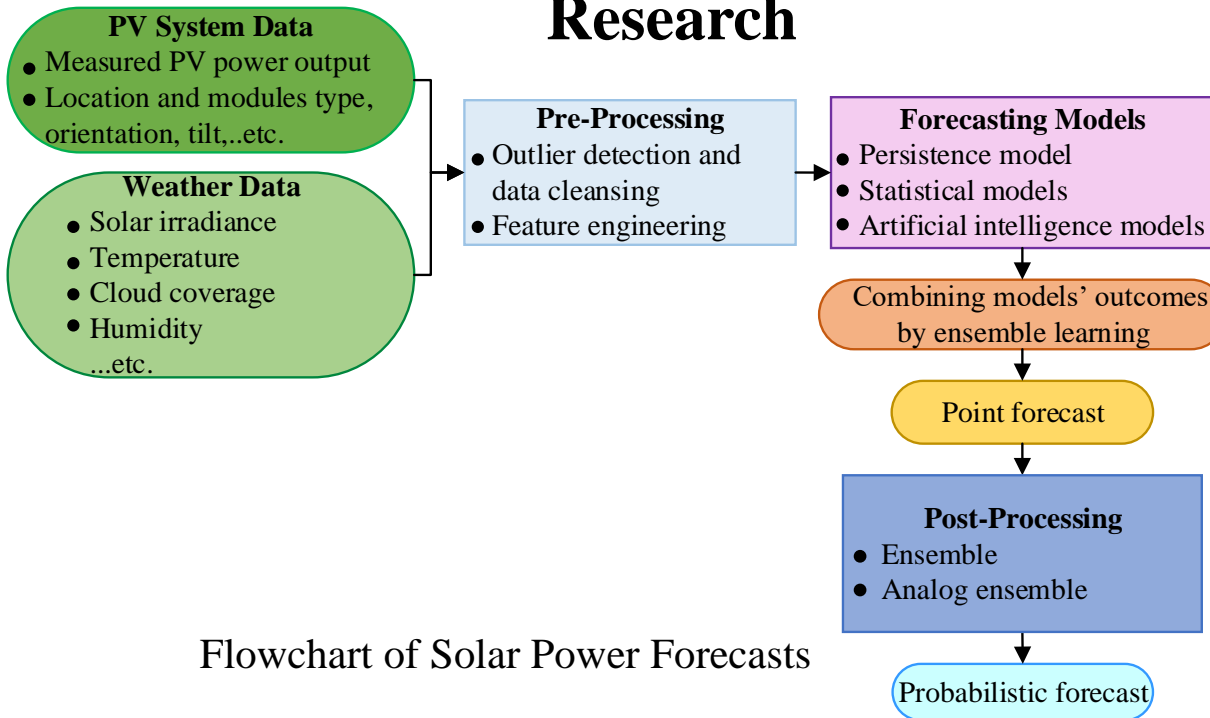


Optimizing the Transformer's Tap Changer position sequences using the solar forecast

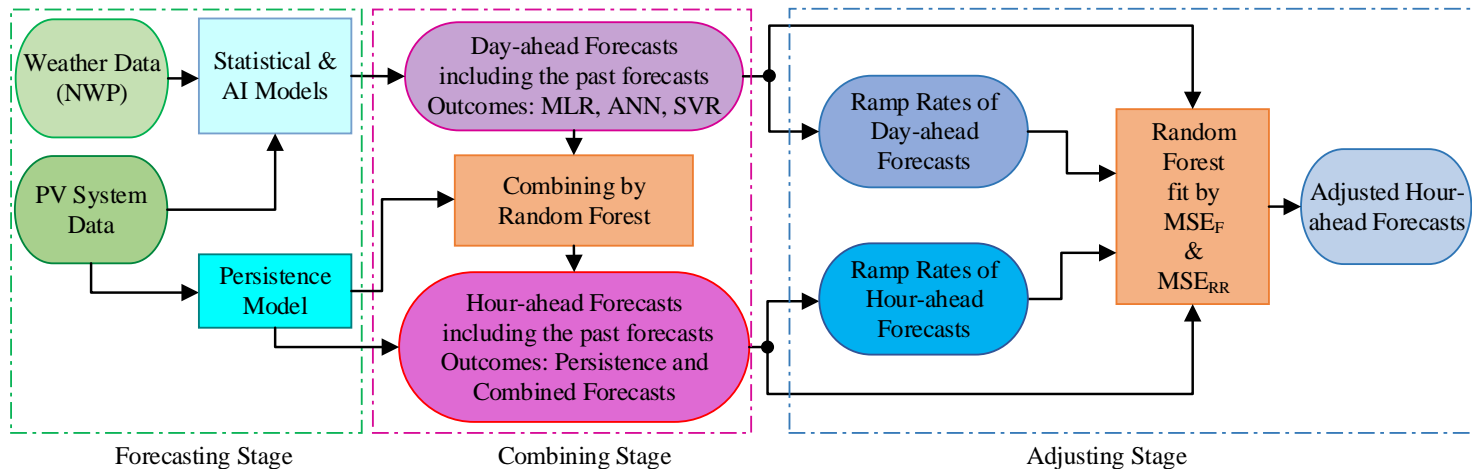


EPEX: European power exchange spot trading

Research

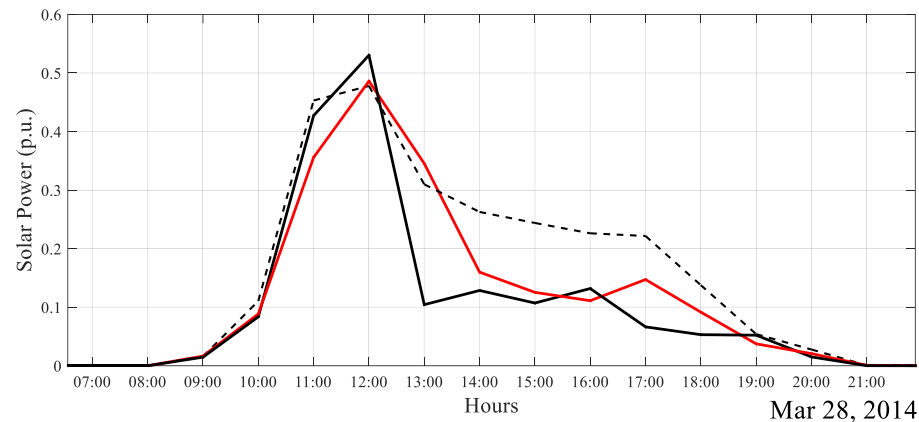
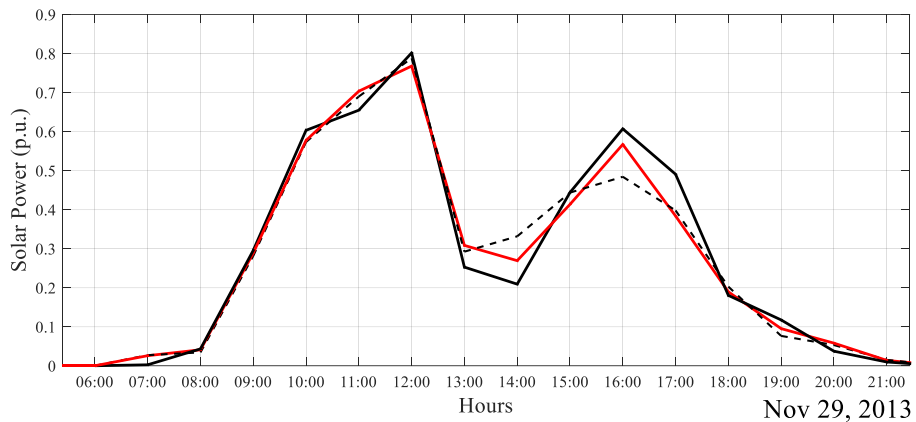
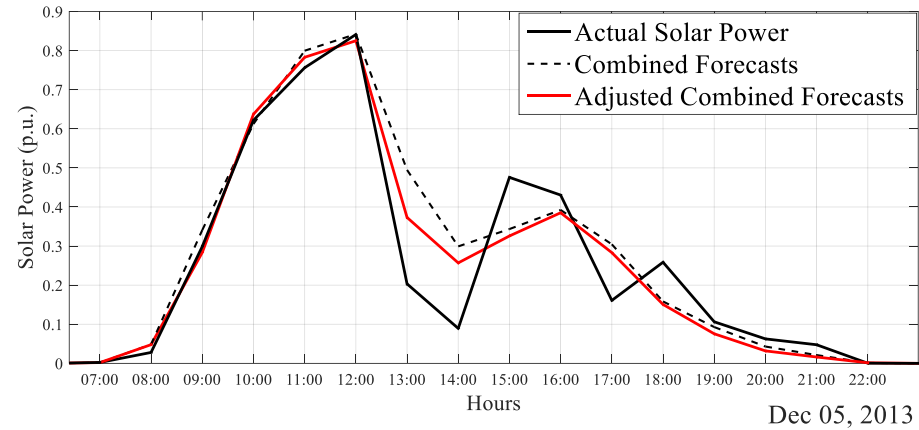
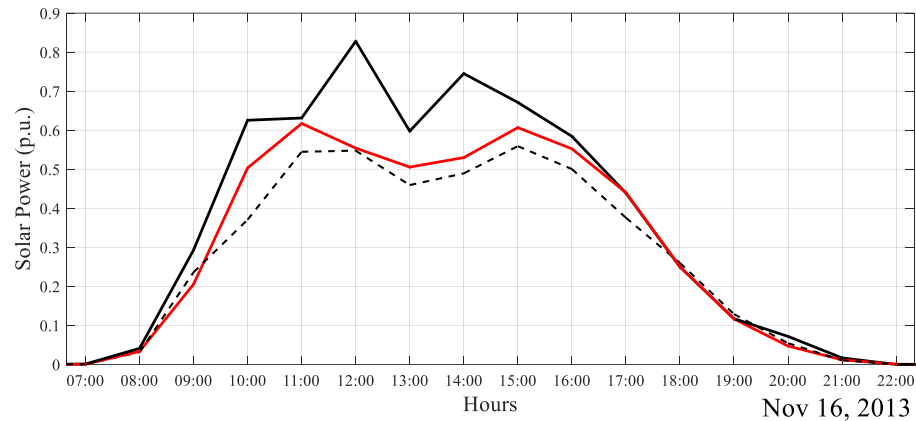


Flowchart of Solar Power Forecasts



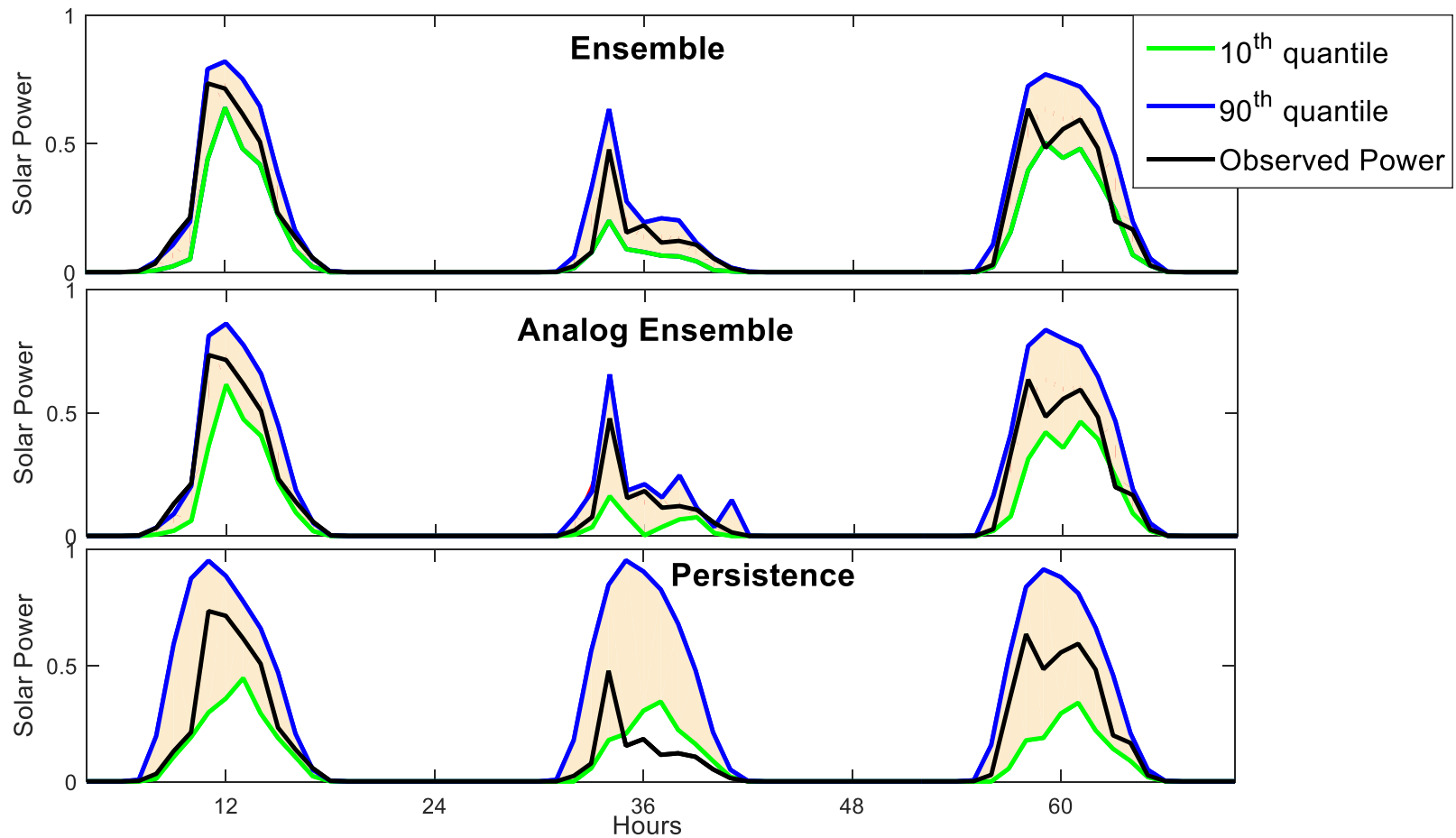
Block diagram of the adjusting approach

Research



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

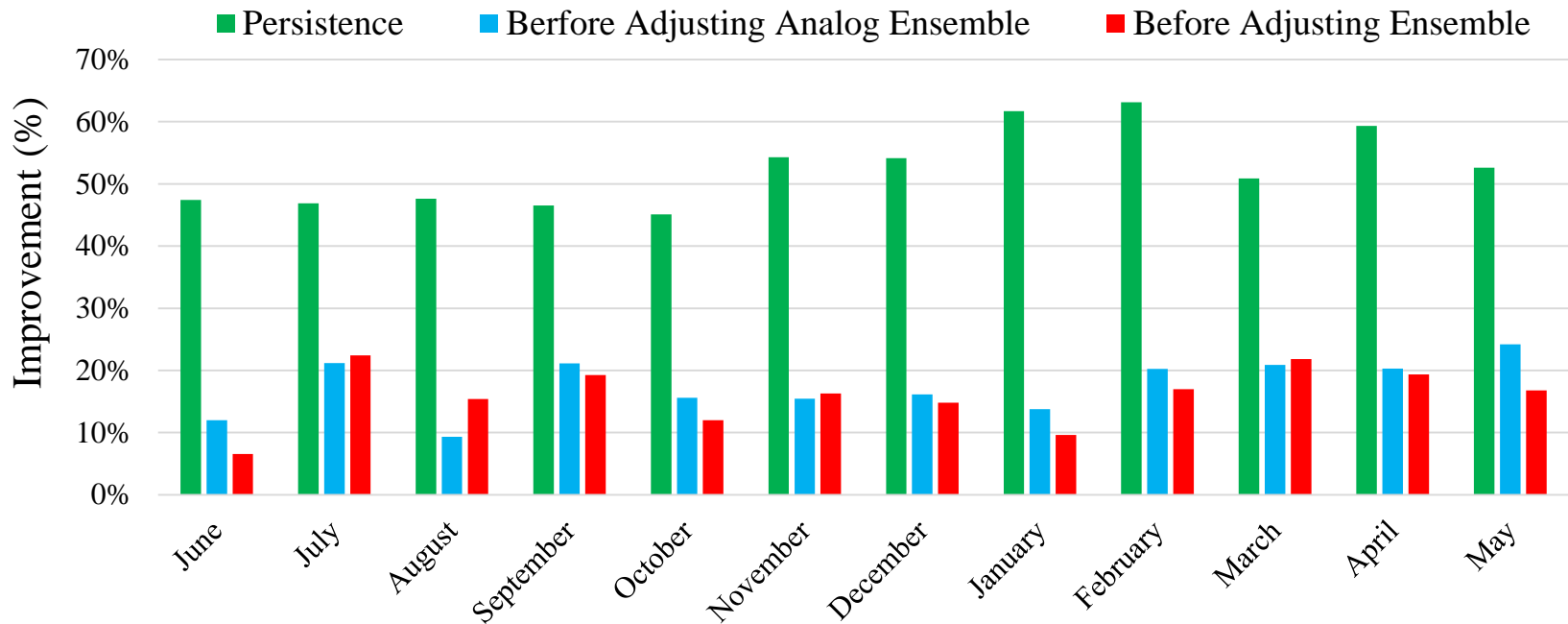
Research



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

Research

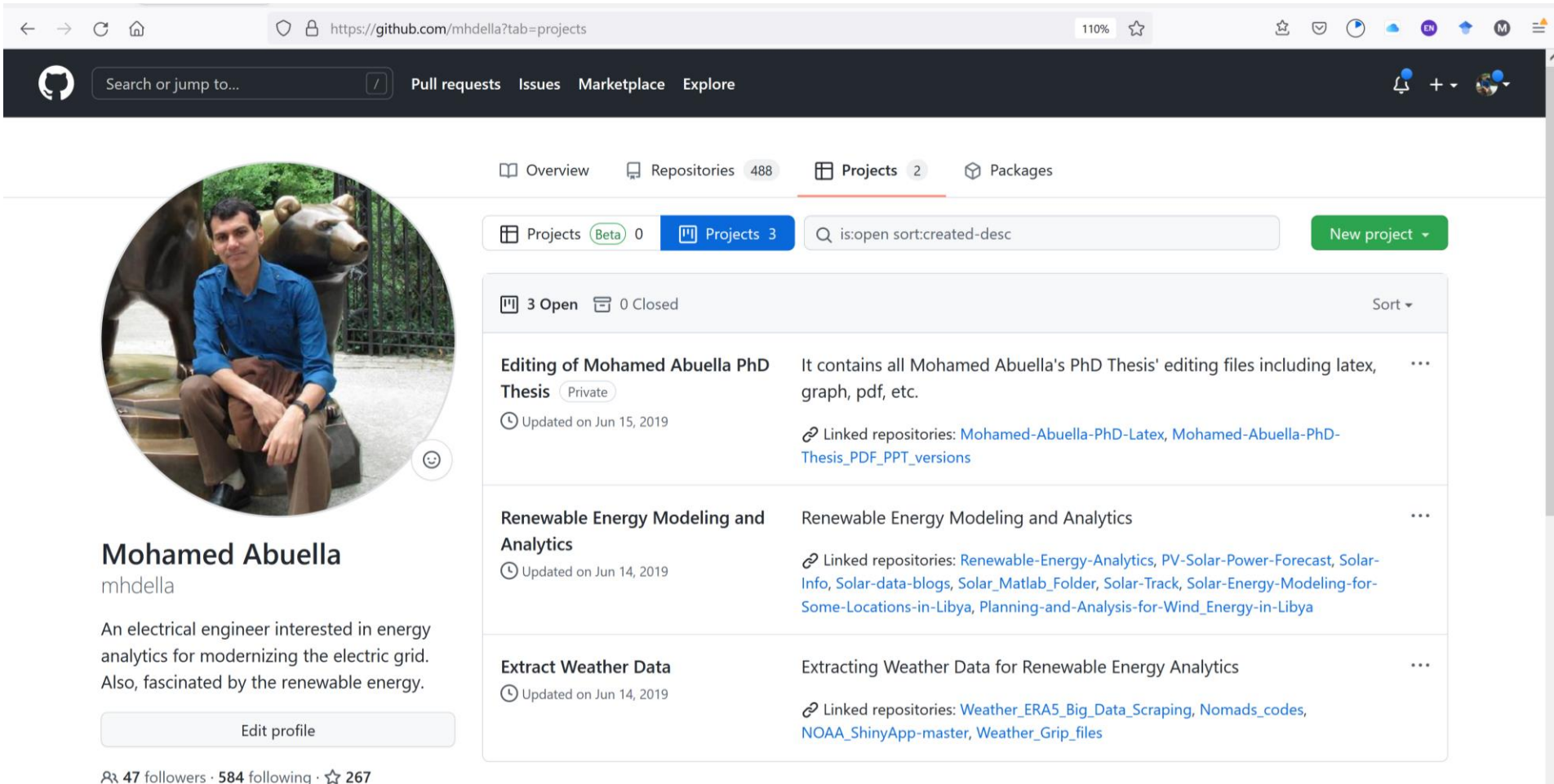
Improvement of Adjusted Ensemble-based Probabilistic Forecasts Over:



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

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 active, displaying 3 open projects and 0 closed projects. The projects listed are:

- Editing of Mohamed Abuella PhD Thesis** (Private): Updated on Jun 15, 2019. Description: 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. Description: 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. Description: Extracting Weather Data for Renewable Energy Analytics. Linked repositories: Weather_ERA5_Big_Data_Scraping, Nomads_codes, NOAA_ShinyApp-master, Weather_Grip_files.

Research

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

Blog

- 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 includes the IEEE logo and the journal title 'IEEE Transactions on Sustainable Energy'. A navigation bar shows 'Home', 'Author', and 'Review' tabs, with 'Review' being the active tab. Below this, a sidebar on the left lists 'Reviewer View Manuscripts' with options like 'Review and Score', 'Scores Submitted', and 'Receive Recognition on Publons'. 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

Research

Interactive Data Dashboard in Jupyter Notebooks

ipywidgets, also known as *jupyter-widgets* or simply *widgets*, are [interactive HTML widgets](https://github.com/mhdella/energyDS/blob/master/Prerequisites/08%20Plotting.ipynb)
<https://github.com/mhdella/energyDS/blob/master/Prerequisites/08 Plotting.ipynb>

To install the widgets on your own computer, follow the instructions at
https://ipywidgets.readthedocs.io/en/latest/user_install.html

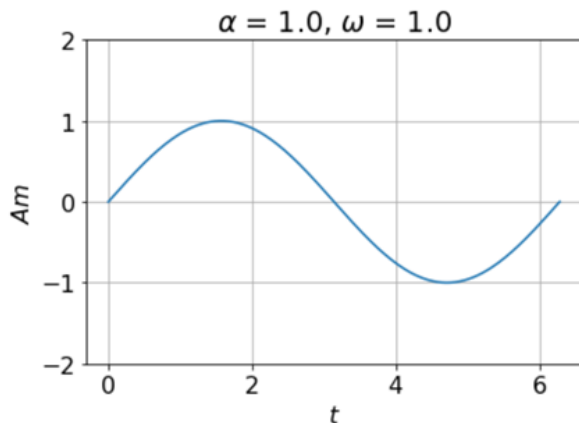
Example:

```
from ipywidgets import interact
..
plt.plot(t,  $\alpha \cdot \sin(\omega \cdot t)$ )
```

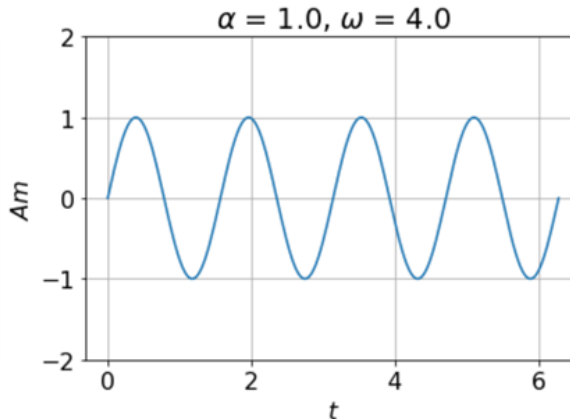
```
In [12]: 1 def plot( $\omega=1$ ,  $\alpha=1$ ):
2         t = np.linspace(0, 2*np.pi, 200)
3         plt.xlabel('$t$')
4         plt.ylabel('$A_m$')
5         plt.ylim((-2,2))
6         plt.title(r'$\alpha$ = {}, $\omega$ = {}'.format( $\alpha$ ,  $\omega$ ))
7         plt.plot(t,  $\alpha \cdot \sin(\omega \cdot t)$ )
8         plt.grid()
9         plt.show()
```

```
In [13]: 1 interact(plot,  $\omega=(-10, 10, 0.25)$ ,  $\alpha=(0, 2, 0.25)$ );
```

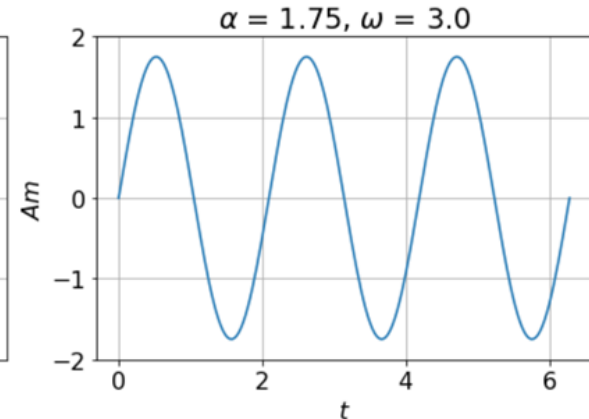
ω 1.00
 α 1.00



ω 4.00
 α 1.00



ω 3.00
 α 1.75

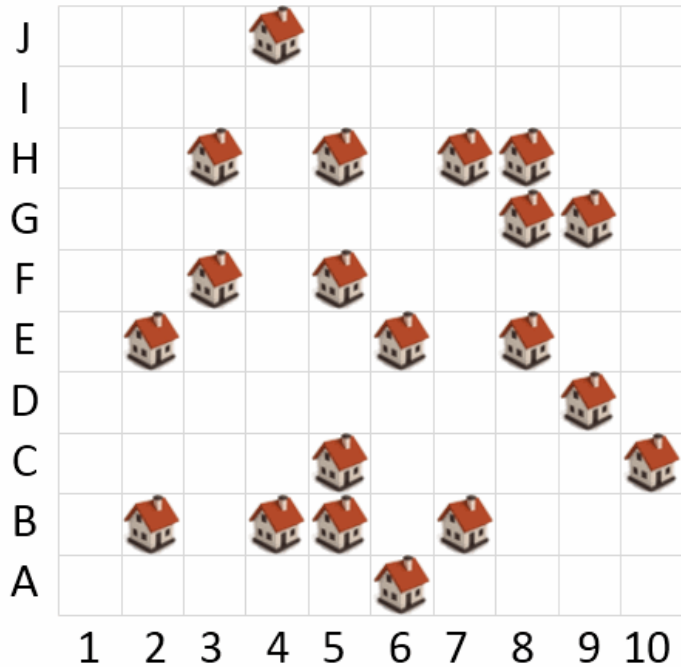


Research

Example of Using Clustering in Electrical Power Systems Planning

C:/Desktop/Py_vars_desktop/optimizingelectricitytransmission-main/optimizingelectricitytransmission-main/Electrifying_PuzzlOR_problem.ipynb

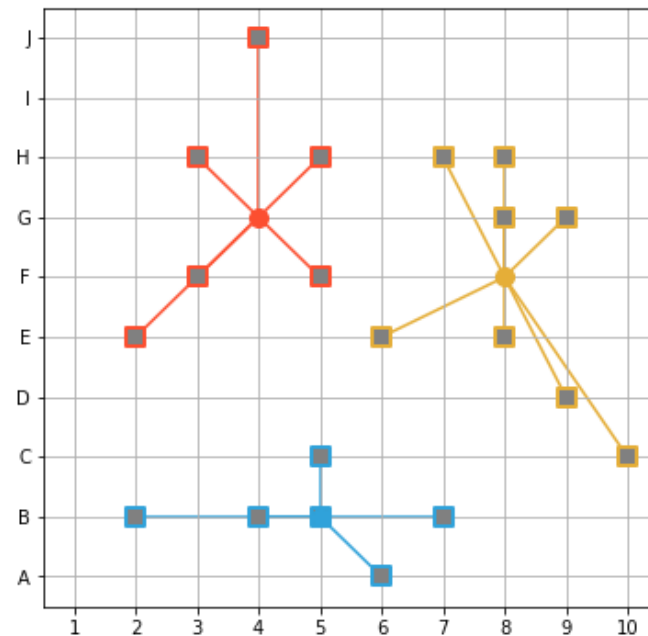
Q: What is the minimum cost required to connect all neighborhoods to electricity?



```
from sklearn.cluster import KMeans

km = KMeans(n_clusters=3)
km.fit(N)

km.cluster_centers_
plot_placements(km.cluster_centers_, N)
```



Thanks for Your Listening

Any Question?

Mohamed Ali Abuella
mabuella@cit.edu.ly
mhdabuella@gmail.com



كلية التقنية الصناعية_مصراته
The College Of Industrial Technology_Misurata




UNC CHARLOTTE
Energy Production and Infrastructure Center (EPIC)