Study of Distributed Smart Renewable Energy Micro-Plants

Presented by : **Hani TERFA** hani.terfa@gmail.com

Supervisor : **Pr. Lotfi BAGHLI** lotfi@baghli.com

Co-Supervisor : **Pr. Ramchandra BHANDARI** ramchandra.bhandari@th-koeln.de

Res 2 Prac

PAUWES

RESEARCH 2 PRACTICE FORUM 2018

ENERGY, WATER SECURITY AND CLIMATE CHANGE IN AFRICA

16th - 18th APRIL, 2018

TLEMCEN, ALGERIA

African Union Commission

Federal Ministry for Economic Cooperation and Development

Federal Ministry of Education and Research

Supported by: giz DLR Projektträger DAAD

Pan African University Institute of Water and Energy Sciences

UNITED NATIONS UNIVERSITY UNU-EHS Institute for Environment and Human Security

Center for Development Research Zentrum für Entwicklungsforschung University of Bonn

ITT Institute for Technology and Resources Management in the Tropics and Subtropics

Res 2 Prac

Summary

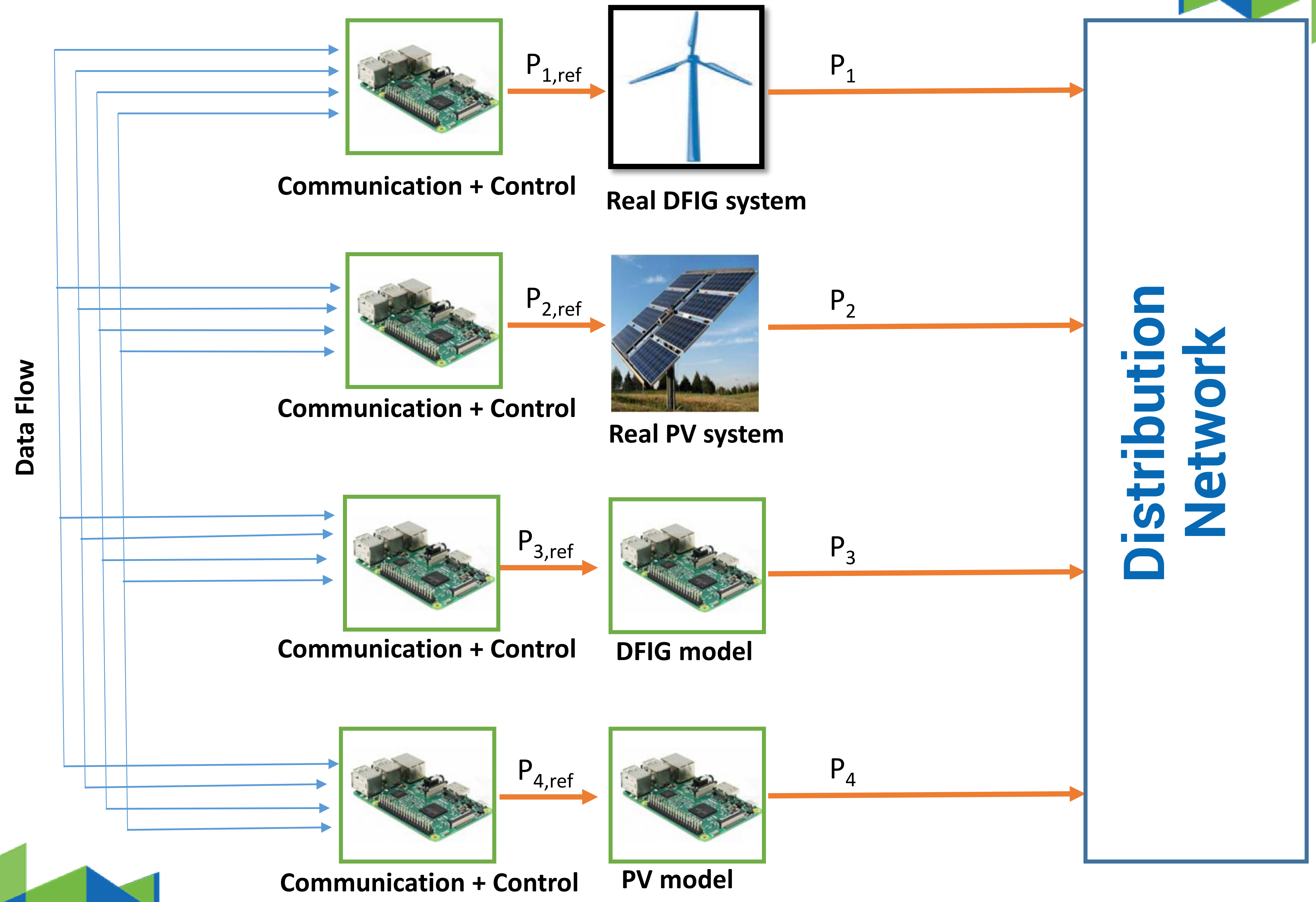
I Abstract

II Load flow & transient stability

III Simulation results

Abstract

- **My main subject consists of managing electricity production from renewable energy (wind & PV) without creating any disturbances in the grid and to absorb them, if they occur, by the variation of the load with time. We should develop strategies to control the micro power plants in a way that each one produces an exact quantity of energy in real time to follow the consumption variation, and of course, to skip the weather limitations.**



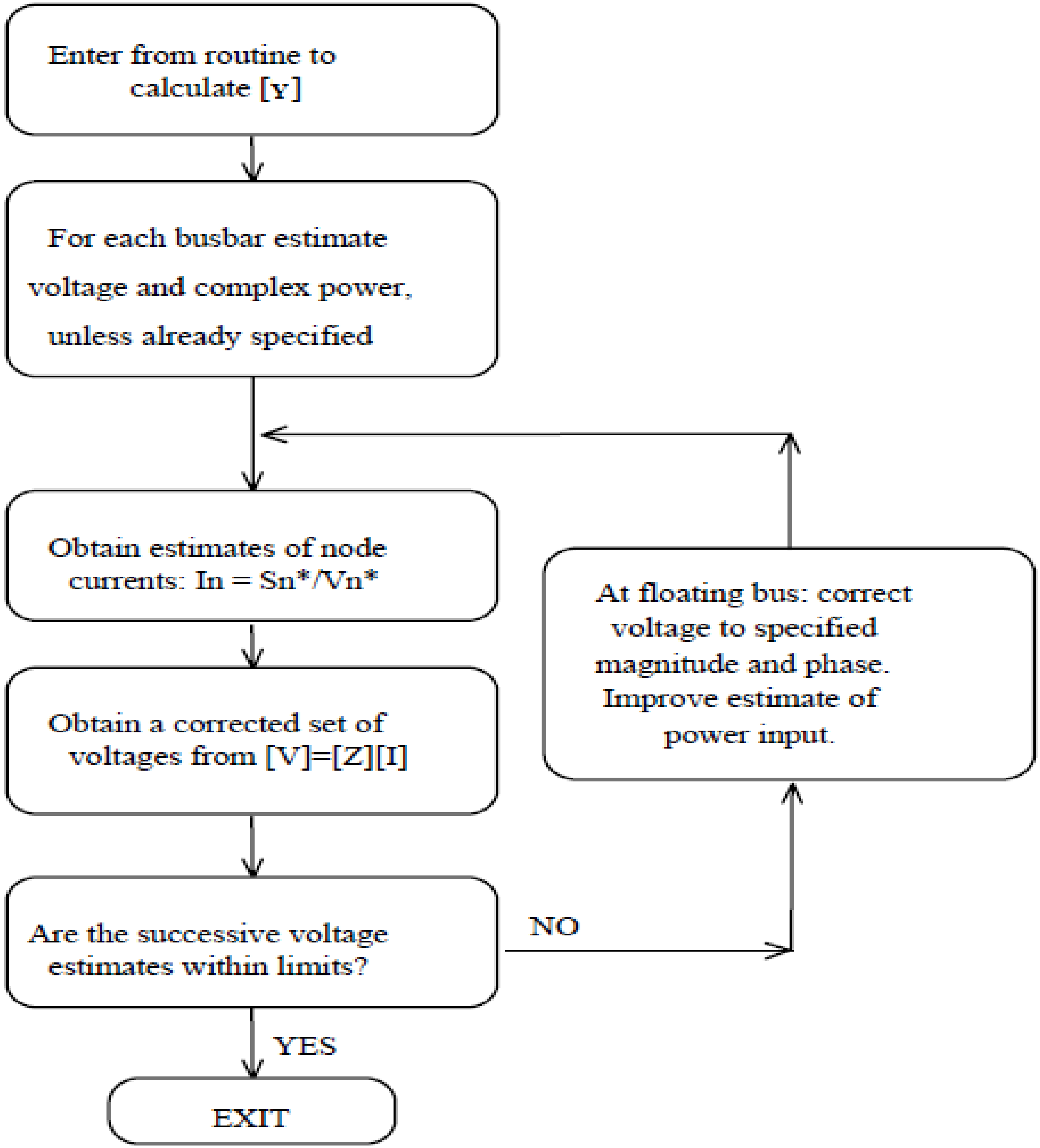
Data Flow
P1,ref
P2,ref
P3,ref
P4,ref
Communication + Control
Communication + Control
Communication + Control
Communication + Control
Real DFIG system
Real PV system
DFIG model
PV model
P1
P2
P3
P4
Distribution Network
Res2Prac

Load flow and transient stability

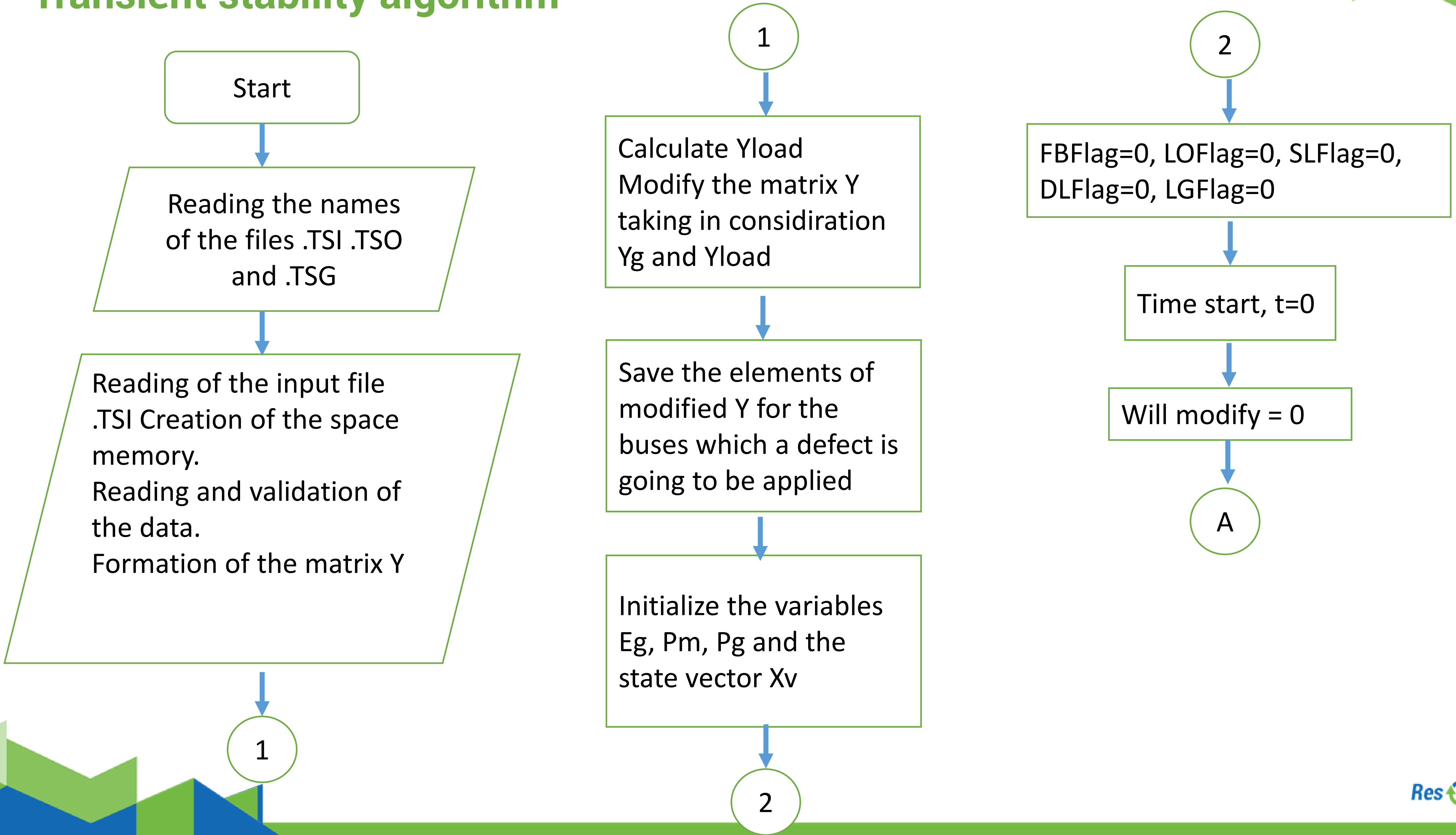
- Intermittent generation (for example: gusting wind or clouds on a sunny day).
- This simple occurrence can destabilize the grid and cause an unwelcome generator response.

- Implement load flow algorithms as well as transient stability computing routines.
- Predict how the system will react on a fault or a change in its structure or in its load or its power generation.
- These information allow the intelligent swarm of micro power plants to take the right decisions.

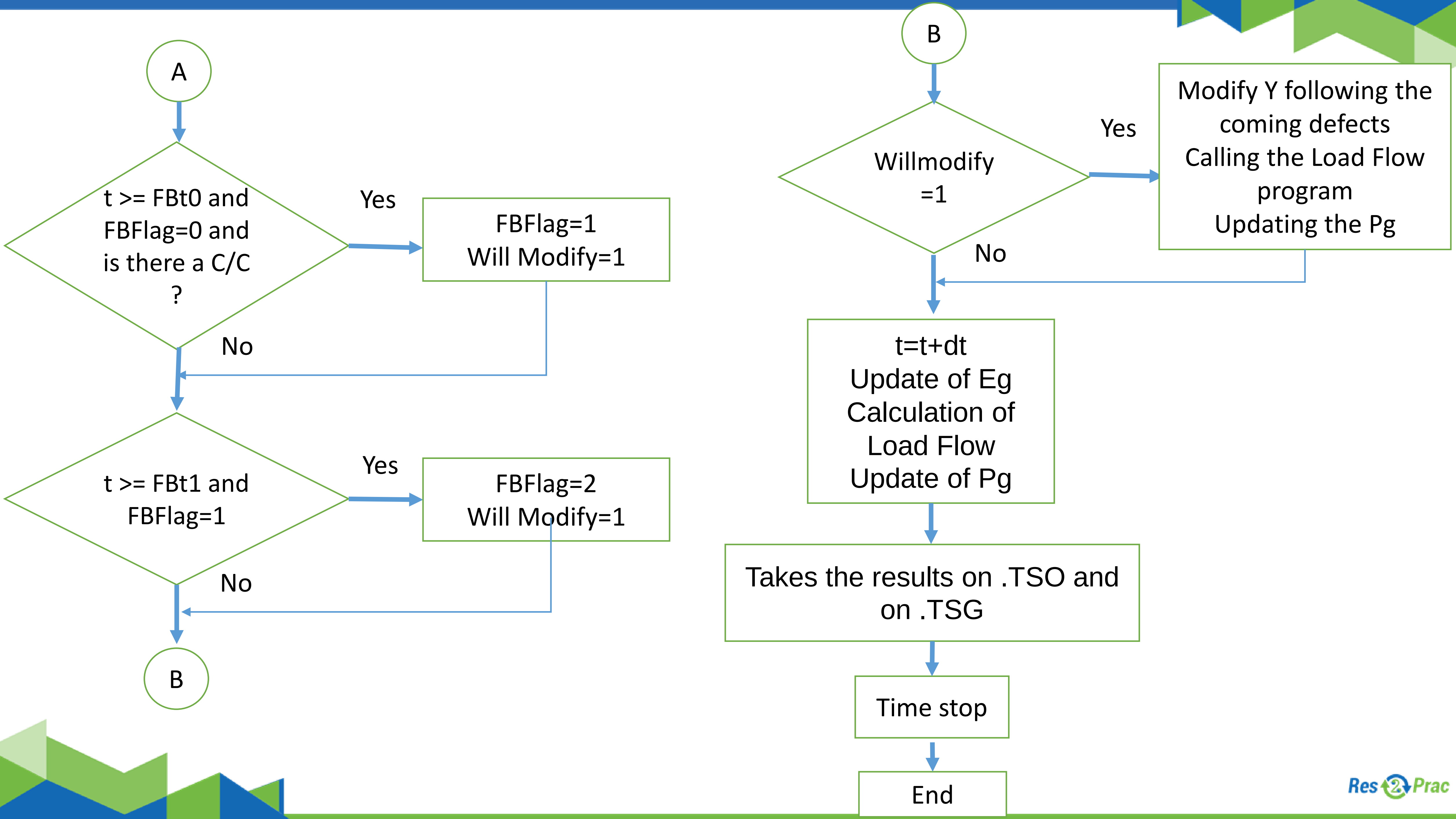
Load flow algorithm



Transient stability algorithm



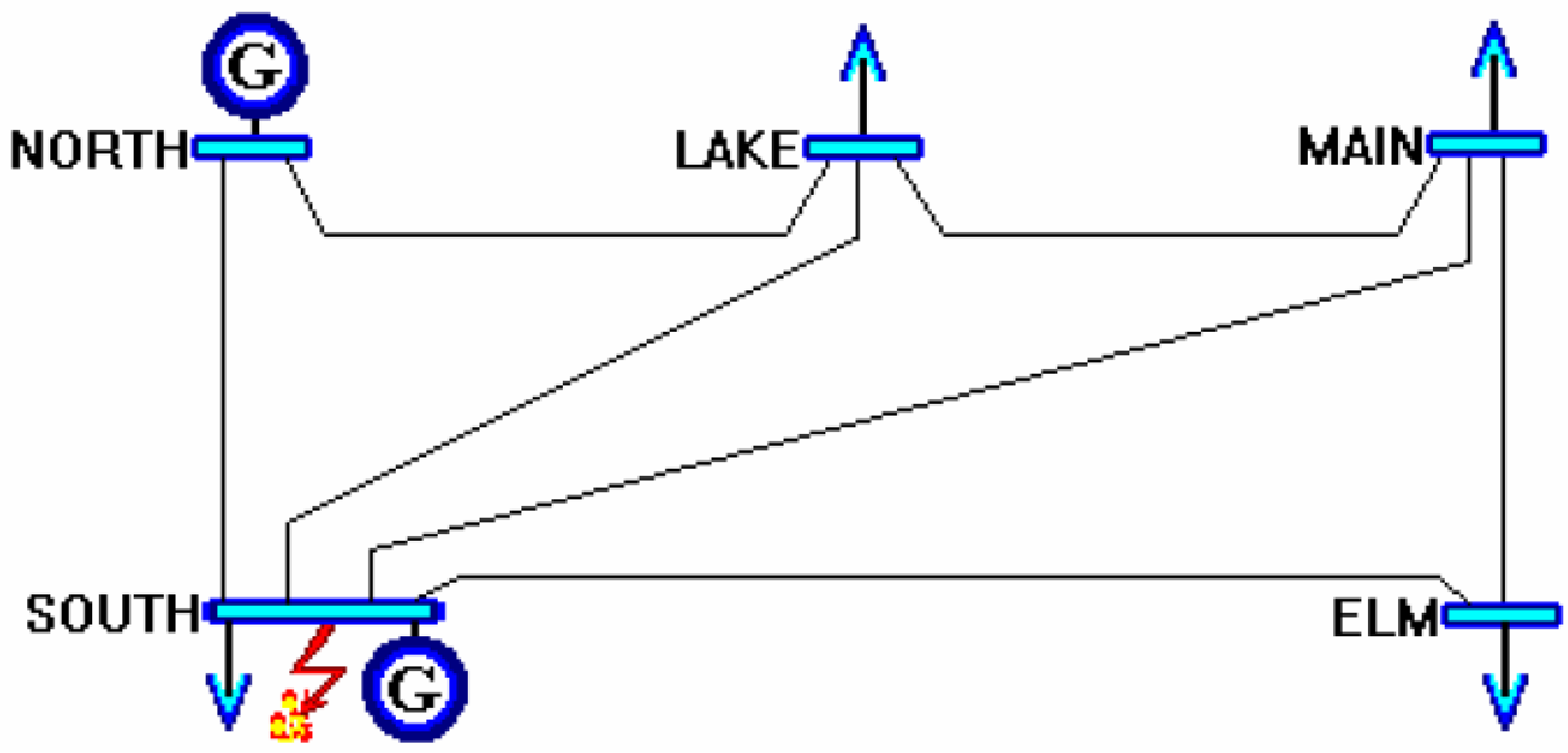
Res2Prac



A
t >= FBt0 and
FBFlag=0 and
is there a C/C
?
Yes
FBFlag=1
Will Modify=1
No
t >= FBt1 and
FBFlag=1
Yes
FBFlag=2
Will Modify=1
No
B
B
Willmodify
=1
Yes
Modify Y following the
coming defects
Calling the Load Flow
program
Updating the Pg
No
t=t+dt
Update of Eg
Calculation of
Load Flow
Update of Pg
Takes the results on .TSO and
on .TSG
Time stop
End

Res2Prac

3 phase short-circuit for a 5 buses power grid in the south node during 0,1s .



Res2Prac

Simulation results

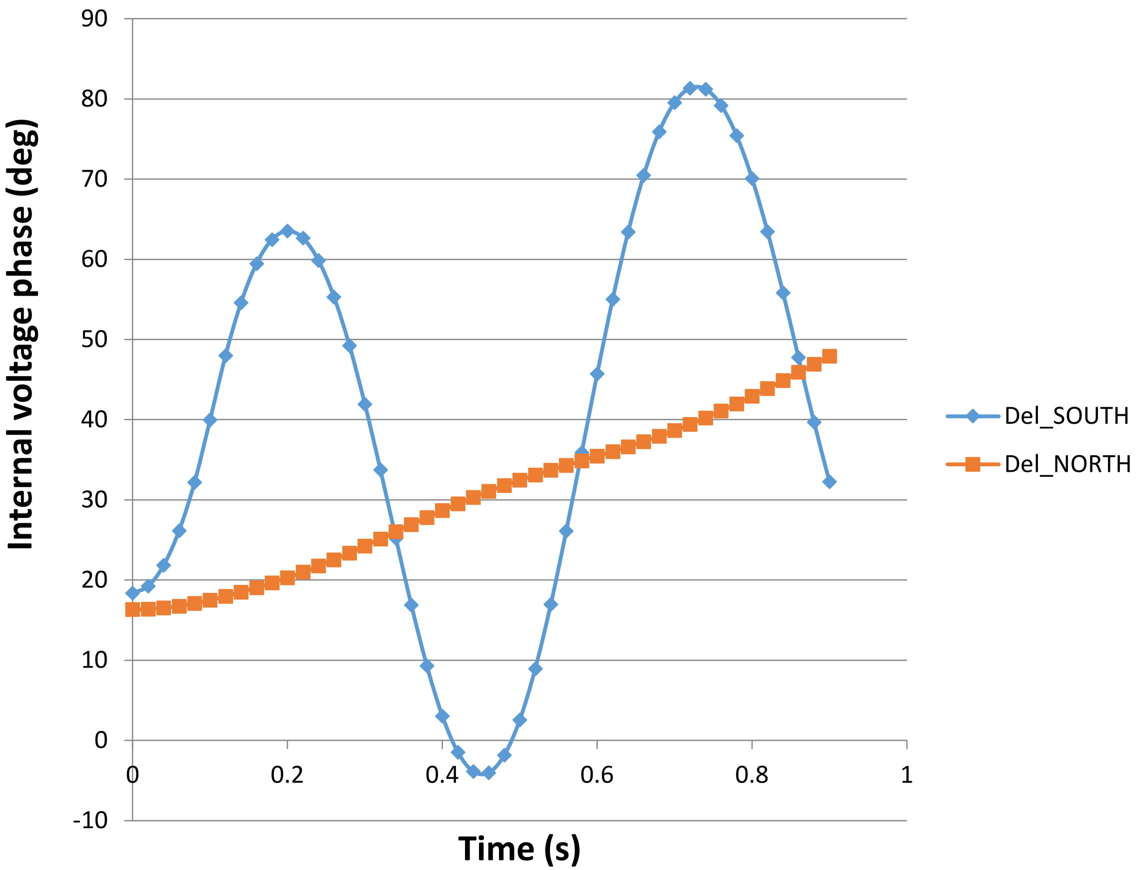


Fig.1: Internal voltage phase of the machines

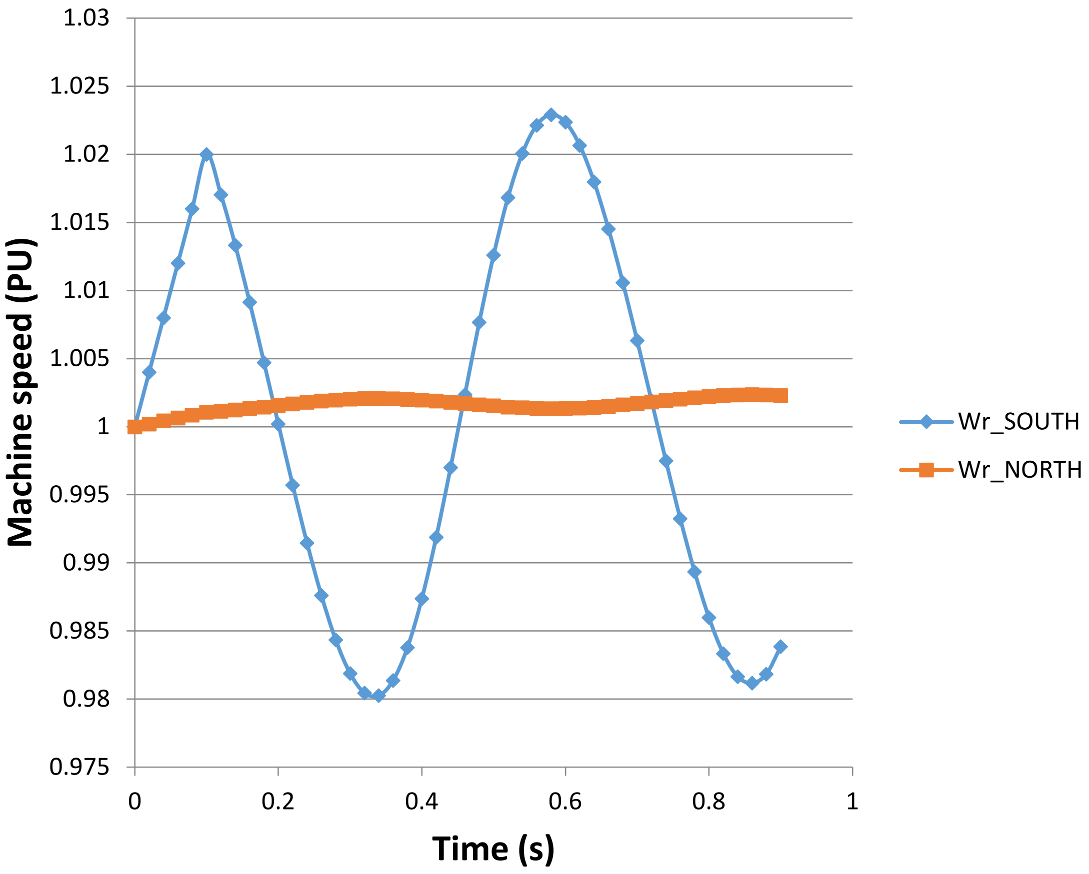


Fig.2: Speed of the machines

Simulation results

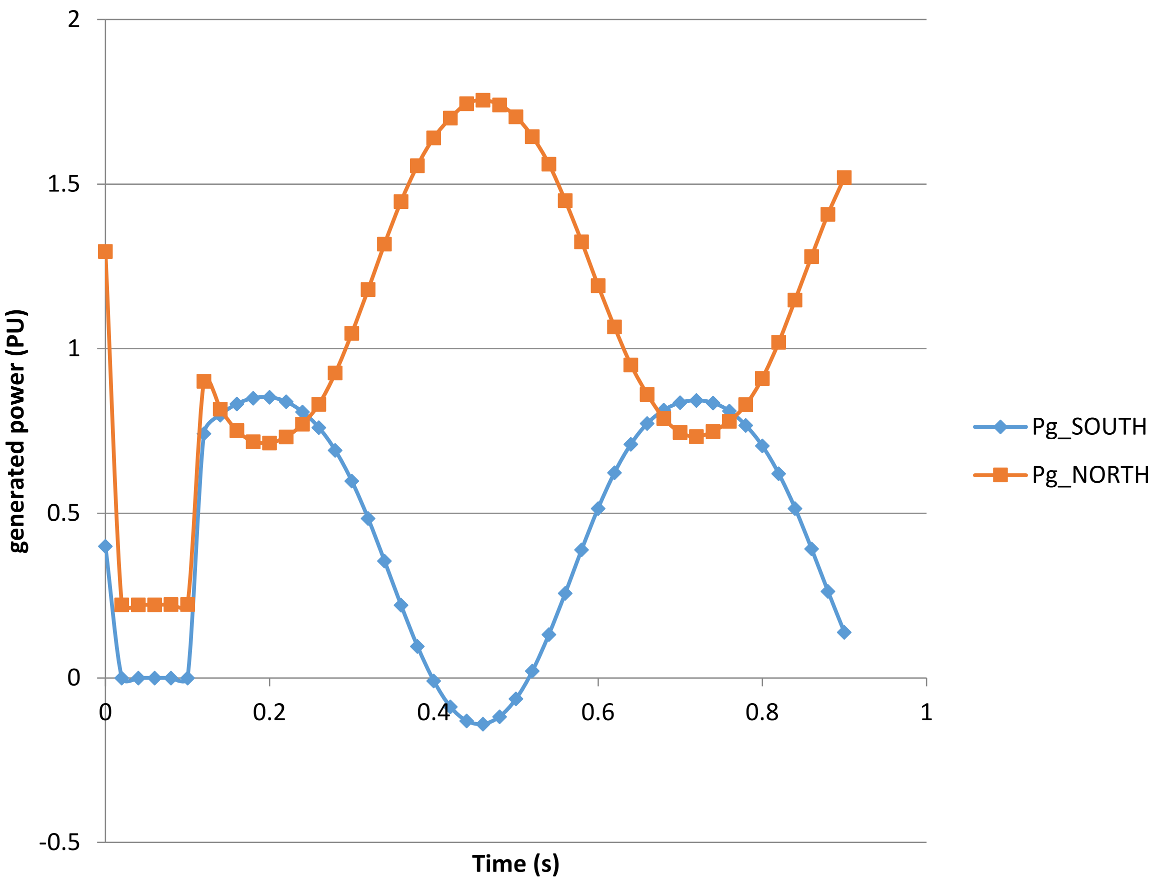


Fig.3: The power generated of the machines

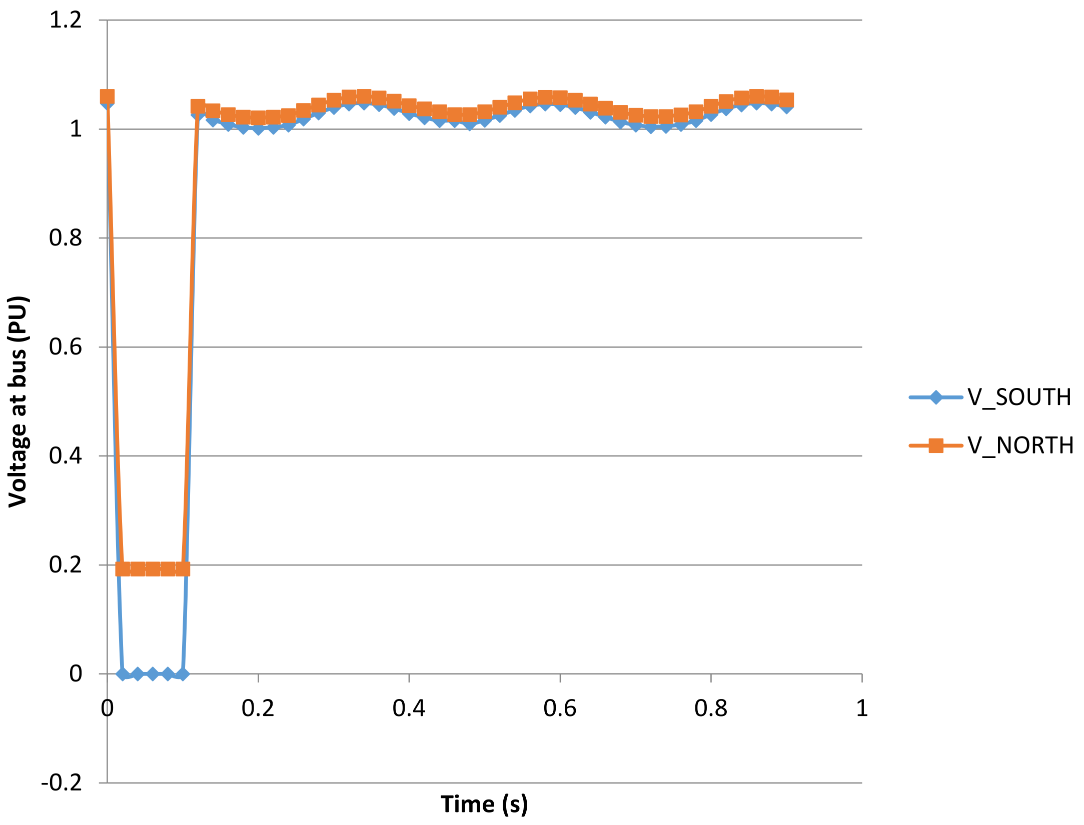


Fig.4: voltage at bus for the machines

Res2Prac

Thanks for your attention

References

[1] L. Baghli, G. Didier, S. Bendali, J. Leveque, “An Open Source Real-Time Power System Simulator with HIL”, International conference on electrical networks ICEN 2010, Sidi Bel Abbes, 28-29 October 2010.

[2] Z. Dekali, L. Baghli, A. Boumediene, “Experimental Implantation of an Emulator of a Wind Energy Conversion Chain System Based on Double Fed Induction Generator.”, 11th Scientific and Technical Days, Innovation and partnership in a global context of energy transition, oran,19th – 22thnovember 2017.

[3] Stagg, G.W. and El-Abiad, A.h., “Computer Methods in Power System Analysis,” Mc Graw Hill, 1968.

[4] Arrillaga, J. and Arnold, C.P., “Computer Analysis of Power Systems,” John Wiley & Sons, 1994.

[5] E. F. Camacho, T. Samad, M. Garcia-Sanz, I. Hiskens, “Control for Renewable Energy and Smart Grids”. http://ieeecss.org/main/IoCT-report.

[6] L.A. Hurtado, P.H. Nguyen, W.L. Kling, “Smart grid and smart building inter-operation using agent-based particle swarm optimization”, ScienceDirect, Sustainable Energy, Grids and Networks 2 (2015) 32–40.

[7] C. Brivio, S. Mandelli, M. Merlo, “Battery energy storage system for primary control reserve and energy arbitrage”, Sustainable Energy, Grids and Networks (2016). http://dx.doi.org/10.1016/j.segan.2016.03.004

[8] J. Jargstorf , C. De Jonghe, R. Belmans, “Assessing the reflectivity of residential grid tariffs for a user reaction through photovoltaics and battery storage ”, Sustainable Energy, Grids and Networks 1 (2015) 85–98.

[9] A. Lawson, M. Goldstein, C.J. Dent, Bayesian framework for power network planning under uncertainty, Sustainable Energy, Grids and Networks (2016). http://dx.doi.org/10.1016/j.segan.2016.05.003

[10] F. Sossan , V. Lakshmanan, G. T. Costanzo, M. Marinelli, P. J. Douglass, H. Bindner, “Grey-box modelling of a household refrigeration unit using time series data in application to demand side management”, Sustainable Energy, Grids and Networks 5 (2016) 1–12.

[11] Y. Zhou, P. Mancarella, J. Mutale, “Modelling and assessment of the contribution of demand response and electrical energy storage to adequacy of supply”, Sustainable Energy, Grids and Networks 3 (2015) 12–23.

[12] M.A. Hamouda, M. Saïdi, A. Louchene, C. Hamouda, A. Malek, " Etude et réalisation d'un système intelligent d'alimentation en énergie électrique d'une habitation en milieu urbain avec injection dans le réseau", *Revue des Energies Renouvelables Vol. 14 N°2 (2011) 187 – 202.*

[13] A. Hamidat, A. Hadj Arab, M. Belhamel, "Etude et réalisation d'une mini centrale photovoltaïque hybride pour l'électrification du refuge Assekrem ", *Revue des Energies Renouvelables Vol. 10 N°2 (2007) 265 – 272.*

[14] R. Kempener (IRENA), P. Komor, A. Hoke, "SMART GRIDS AND RENEWABLES : A Guide for Effective Deployment", International Renewable Energy Agency, November 2013.

[15] P. Ledesma, J. Usaola, "Doubly Fed Induction Generator Model for Transient Stability Analysis", IEEE transactions on energy conversion, vol. 20, no. 2, june 2005.

[16] N. Hamrouni, A. Chérif , "Modelling and control of a grid connected photovoltaic system", *Revue des Energies Renouvelables Vol. 10 N°3 (2007) 335 – 344.*

As researchers or practitioners what are the possible interactions/collaboration with practitioners resp. researchers to improve/upscale your activities

The collaboration with researchers or practitioners has a set of benefits such as:

- **providing us with new ideas to solve the research problems,**

What are the potential aspects of the research that can be transformed into practice?