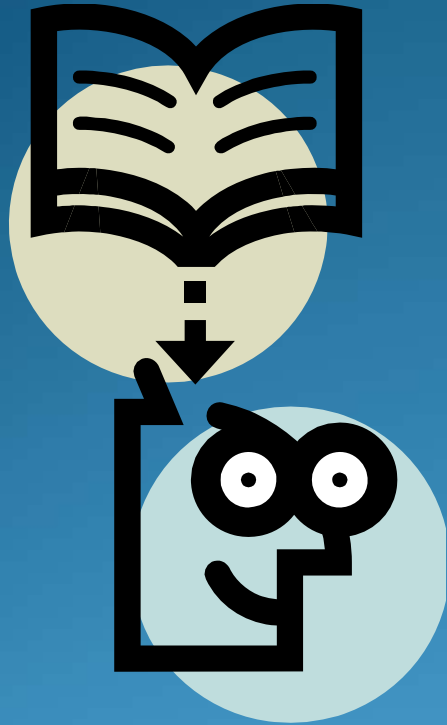


Antonio Gómez Expósito

the scholar ...

Chronological Appointments

- 2007-:** Director of the “Endesa Red” Chair, University of Seville
- 2006-:** Director of the Master program: “Electric Energy Systems”
- 2003-:** Director of the Ph.D. program: “Technical and Economic Management of Generation, Transmission and Distribution Electrical Systems”
- 2003-present:** Chairman, Department of Electrical Engineering
- 1992-present:** Full Professor, University of Seville
- 1998 (summer term):** Visiting Professor, University of Waterloo
- 1991-1994:** Chairman, Department of Electrical Engineering
- 1987-1992:** Associate Professor, University of Seville
- 1988 :** Adjunct Faculty, San Diego State University (California)
- 1985-1987:** Assistant Professor, University of Seville
- 1982-1985:** Lecturer, University of Seville



Early Years ...

1987-89



Sparsity Methods

Fast Solution of Linear Equations

Sparse matrix/vector methods

1987 – IEEE PES Winter Meeting, New Orleans

Presented a paper on *Node Ordering Algorithms for Sparse Vector Methods*

Ordering algorithms allow efficient use of sparse vector methods for special power system applications.

“An Efficient Ordering Algorithm to Improve Sparse Vector Methods”. A. Gomez, L.G. Franquelo. **IEEE Trans. on Power Systems**, vol. 3(4), pp. 1538-1544, November 1988.

“Node Ordering Algorithms for Sparse Vector Method Improvement”. A. Gomez, L.G. Franquelo. **IEEE Trans. on Power Systems**, vol. 3(1), pp. 73-79, February 1988.



Expanding Research ...

1990's



State Estimation

1992 – 1999 *Inclusion of Ampere measurements in State Estimation.*

Ampere measurements are crucial in sub-transmission networks but typically ignored by existing state estimators or used only if they are redundant.

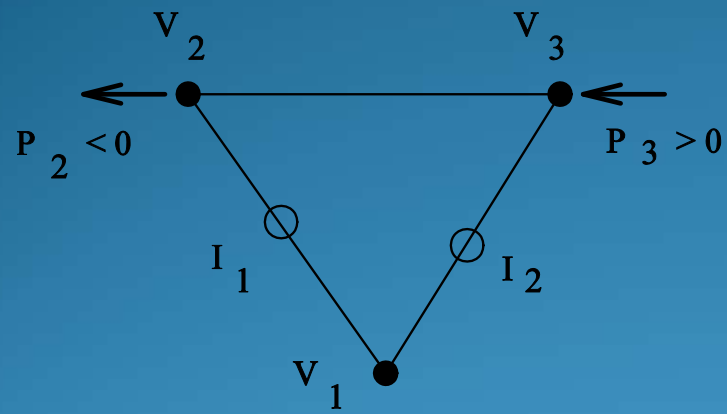
In 1992 he wrote the first paper on inclusion of Ampere measurements. Since then, he conducted several research projects and wrote papers that address:

- observability
- bad data detection
- numerical robustness

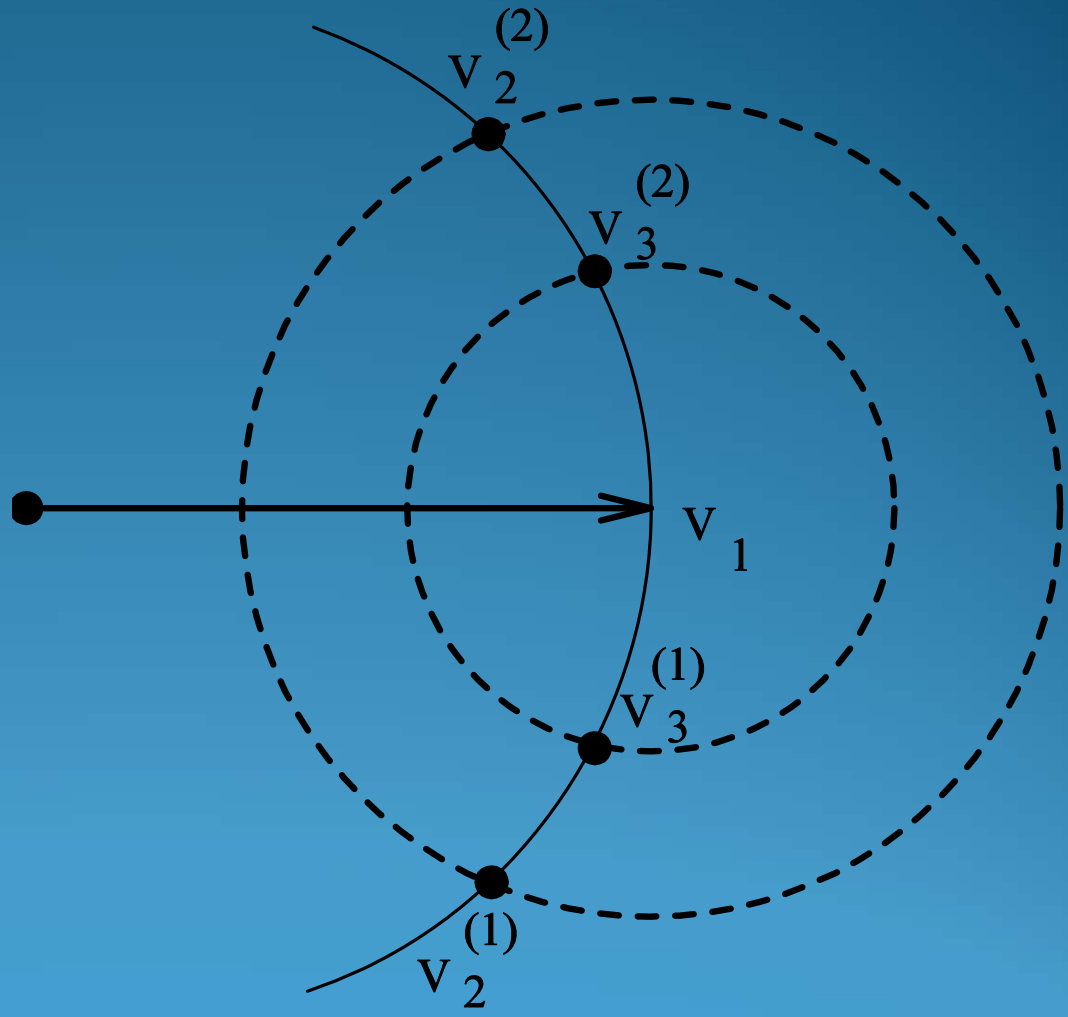
Significant contributions:

- The notion of *unique observability*
- Development of practical procedures to determine whether a network is observable or not in the presence of current measurements

Ampere Measurements



← : Inequality Constraint



Reactive Power/Voltage Control and Optimization

“A Hybrid Tool to Assist the Operator in Reactive Power/Voltage Control and Optimization”. J.L. Martinez, A. Gomez, J. Cortes, E. Mendez, Y. Cuellar. **IEEE Trans. on Power Systems**, vol. 10(2), pp. 760-768, May 1995.

He initiated and managed a large-scale development project aimed at developing an **Expert System** for power loss minimization through reactive power and voltage control.

This practical tool has since been used for several years by:

- Red Eléctrica,
- The Spanish ISO, in its central and regional control centers,
- Endesa, which has tailored the system to its distribution network.

A key for the success of the Expert System among the operators was the introduction of the so-called *Efficiency Coefficients*, allowing different control variables to be ranked in terms of their capability to solve voltage violations or to reduce losses.

Fast Moving-Window DFT Algorithms

“Recursive Formulation of Short-Time Discrete Trigonometric Transforms”. J.A. Rosendo, A. Gomez. **IEEE Trans. on Circuits and Systems, part II Analog and Digital Signal Processing**, vol. 45(4), pp. 525-527, April 1998.

“Efficient Moving-Window DFT Algorithms”. J.A. Rosendo, A. Gomez. **IEEE Trans. on Circuits and Systems, part II, Analog and Digital Signal Processing**, vol. 45(2), pp. 256-260, February 1998.

He has co-developed extremely fast and numerically robust moving-window Discrete Fourier Transform (DFT) algorithms to be embedded in new generations of digital protection and measurement devices.

Some of these algorithms were tested, under his supervision, on a prototype digital differential relay for three-winding transformers that was later manufactured and sold by Artech Hermanos, the Spanish leading company in protection equipment.

Moving into a New Century ...

2000's



Contributions to Power Flow Methods

“Slack Bus Selection to Minimize the System Power Imbalance in Load Flow Studies”. A. Gomez, J.L. Martinez, J. Riquelme, **IEEE Trans. on Power Systems**, vol. 19 (2), pp. 987-995, May 2004.

“Quasi-Coupled Three-Phase Radial Load Flow”. E. Romero, A. Gomez, G. Alvarez. **IEEE Trans. on Power Systems**, vol. 19 (2), pp. 776-781, May 2004.

“A Compact and Flexible Three-Phase Power Flow Based on a Full Newton Formulation”. J. Garcia, M. Izzeddine, S. Martinez, R. Asensi, A. Gomez, W. Xu. **IEE Proceedings on Transmission, Generation and Distribution**, Vol 149(2), pp. 225-232, March 2002.

“Augmented Rectangular Load Flow Model”. A. Gomez, E. Romero. **IEEE Trans. on Power Systems**, vol. 17 (2), pp. 271-2276, May 2002.

“Reliable Load Flow Technique for Radial Distribution Networks”. A. Gomez, E. Romero. **IEEE Trans. on Power Systems**, vol. 14 (3), pp. 1063-1069, August 1999.

Can the slack bus be selected to minimize system power imbalance ?

Contributions of work:

- 1) an original and simple criterion to select the slack bus without user intervention;
- (2) a theoretical development providing further insight into the implications of choosing a single or distributed slack bus from the point of view of losses;
- (3) an algebraic and geometrical justification about the remote possibility of a distributed slack bus being preferable to a single slack when the power imbalance is a concern.

Improving the performance of power flow solution

Contributions of work:

Instead of combining the nodal equations and the bus constraints into a single set of $2N$ nonlinear equations, the NR method is applied to the two primitive sets of equations.

The enlarged model, in which current injections are retained in the state vector, leads to a very simple solution methodology if rectangular coordinates are adopted.

A straightforward approach to dealing with PV buses is also proposed.

Experiments confirm that, depending on the number of PV buses, the computational effort per iteration ranges between 50 and 80% of that required by polar formulations.

Contributions to Generalized SE

“Substation Data Validation by a Local Three-Phase Generalized State Estimator”, A. de la Villa, P. Cruz, A. Gomez, **IEEE Trans. on Power Systems**, vol. 20 (1), pp. 264-271, February 2005.

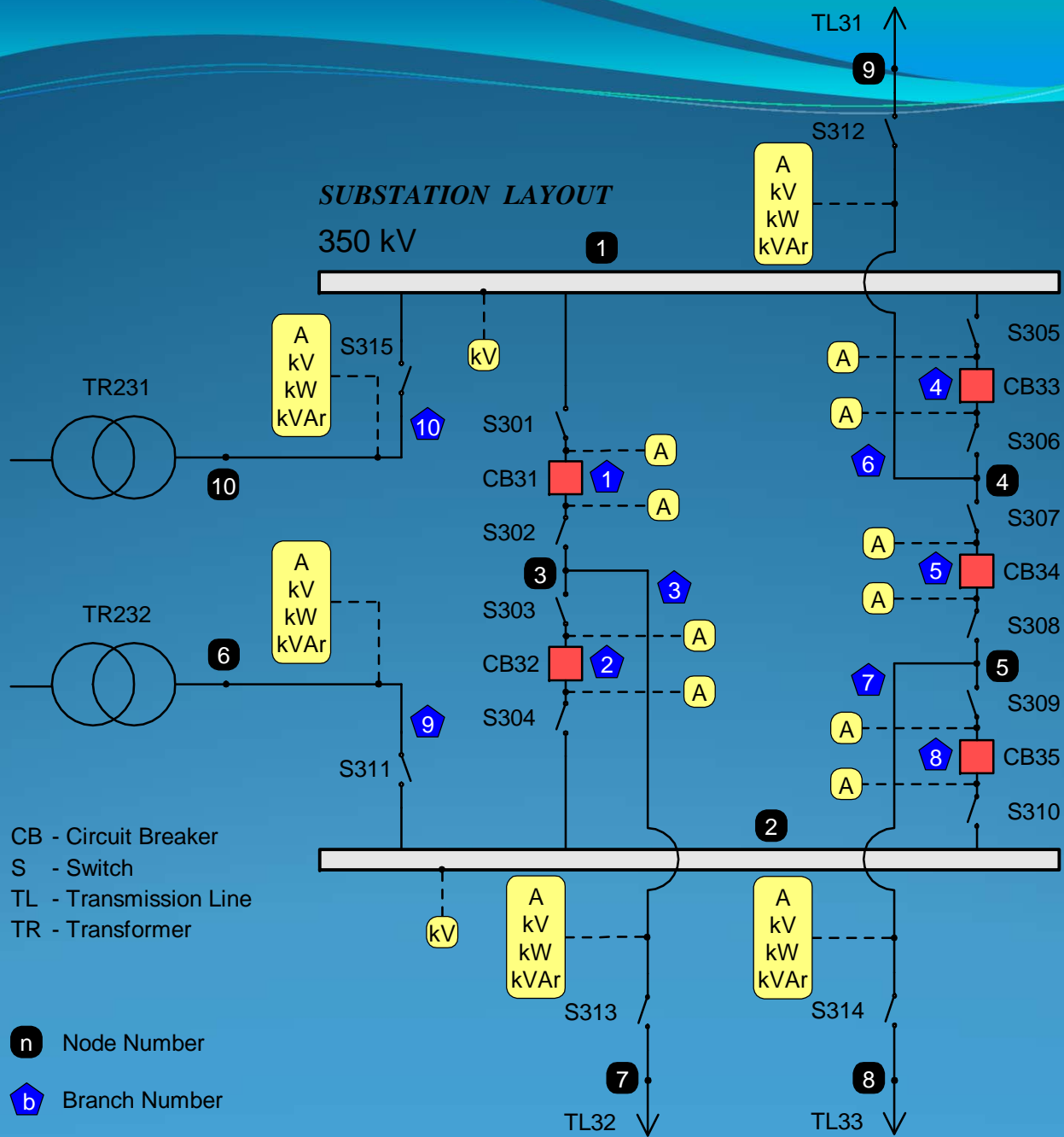
“Including Ampere Measurements in Generalized State Estimators”, A. de la Villa, A. Gomez, **IEEE Trans. on Power Systems**, vol. 20 (2), pp. 603-610, May 2005.

“Implicitly Constrained Substation Model for State Estimation”. A de la Villa, A. Gomez, **IEEE Trans. on Power Systems**, vol. 17 (3), pp. 850-856, August 2002.

“Reduced Substation Models For Generalized State Estimation”. A. Gomez, A. de la Villa. **IEEE Trans. on Power Systems**, vol. 16(4), pp. 839-846, November 2001.

SUBSTATION LAYOUT

350 kV

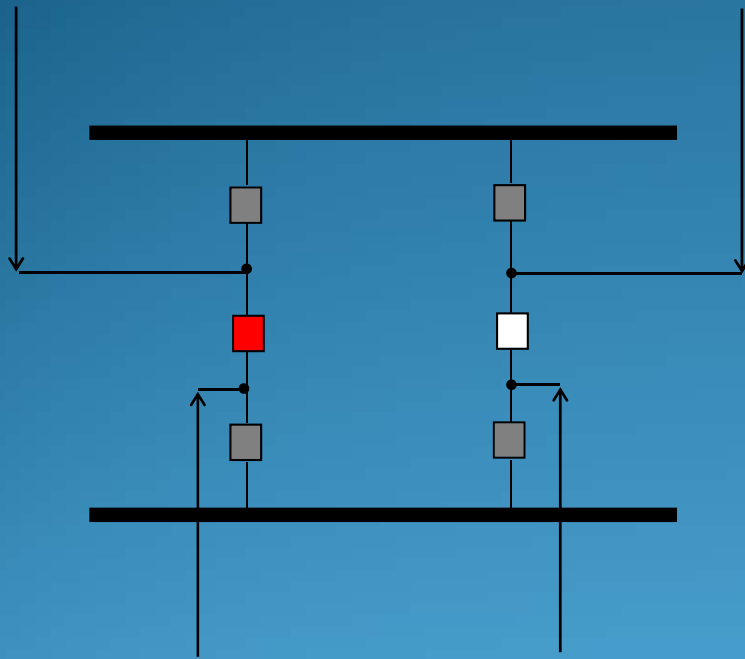


CB - Circuit Breaker
 S - Switch
 TL - Transmission Line
 TR - Transformer

n Node Number
b Branch Number

Topology error identification

Model complexity limited the use of this explicit model only at certain suspected substations, which requires a two-step procedure.



■ Closed ■ Opened ■ Wrong Status

Technical Contribution:

An implicit model is developed. It retains the capability to detect and identify topology errors at virtually the same cost as that of the conventional model that ignores circuit breakers.

Contributions to Digital Signal Processing

“A Performance Comparison Between Kalman Filters and STDFT for Harmonic Estimation”, J.A. Rosendo, A. Gomez, **WSEAS Transactions on Power Systems**, No. 2, Vol. 1, pp. 460-465, February 2006.

“Self-tuning of Kalman Filters for Harmonic Computation”, J.A. Rosendo, A. Gomez, Letters Section of **IEEE Transactions on Power Delivery**, vol. 21 (1), pp. 501-503, January 2006.

“Efficient Computation of the Running Discrete Haar Transform”, J.A. Rosendo, A. Gomez, Letters Section of **IEEE Trans. on Power Delivery**, vol. 21 (1), pp. 504-505, January 2006.

“Computation of Running Averages”, J.A. Rosendo, A. Gomez, **IEEE Trans. on Circuits and Systems II**, vol. 53(10), pp. 1098-1102, October 2006.

Wind Energy Applications

“Frequency Regulation Contribution through Variable Speed Wind Energy Conversion Systems”, J.M. Mauricio, A. Marano, A. Gomez, J.L. Martinez, **IEEE Trans. on Power Systems**, vol. 24 (1), pp. 173-180, February 2009.

“An Electrical Approach to Mechanical Effort Reduction in Wind Energy Conversion Systems”, J.M. Mauricio, A. Leon, A. Gomez, J. Solsona, **IEEE Trans. on Energy Conversion**, vol. 23 (4), pp. 1108-1110, December 2008.

“An Adaptive Nonlinear Controller for DFIM-Based Wind Energy Conversion Systems”, J.M. Mauricio, A. Leon, A. Gomez, J. Solsona, **IEEE Trans. on Energy Conversion**, vol. 23 (4), pp. 1025-1035, December 2008.

Multi-Area State Estimation

“Two-Level State Estimation with Local Measurement Pre-Processing”, A. Gomez, A. de la Villa, **IEEE Trans. on Power Systems**, vol. 24 (2), pp. 676-684, May 2009.

“A Taxonomy of Multi-Area State Estimation Methods”, A. Gomez, A. de la Villa, C. Gomez, T. van Cutsem, P. Rousseaux, **Electric Power Systems Research**, in press.

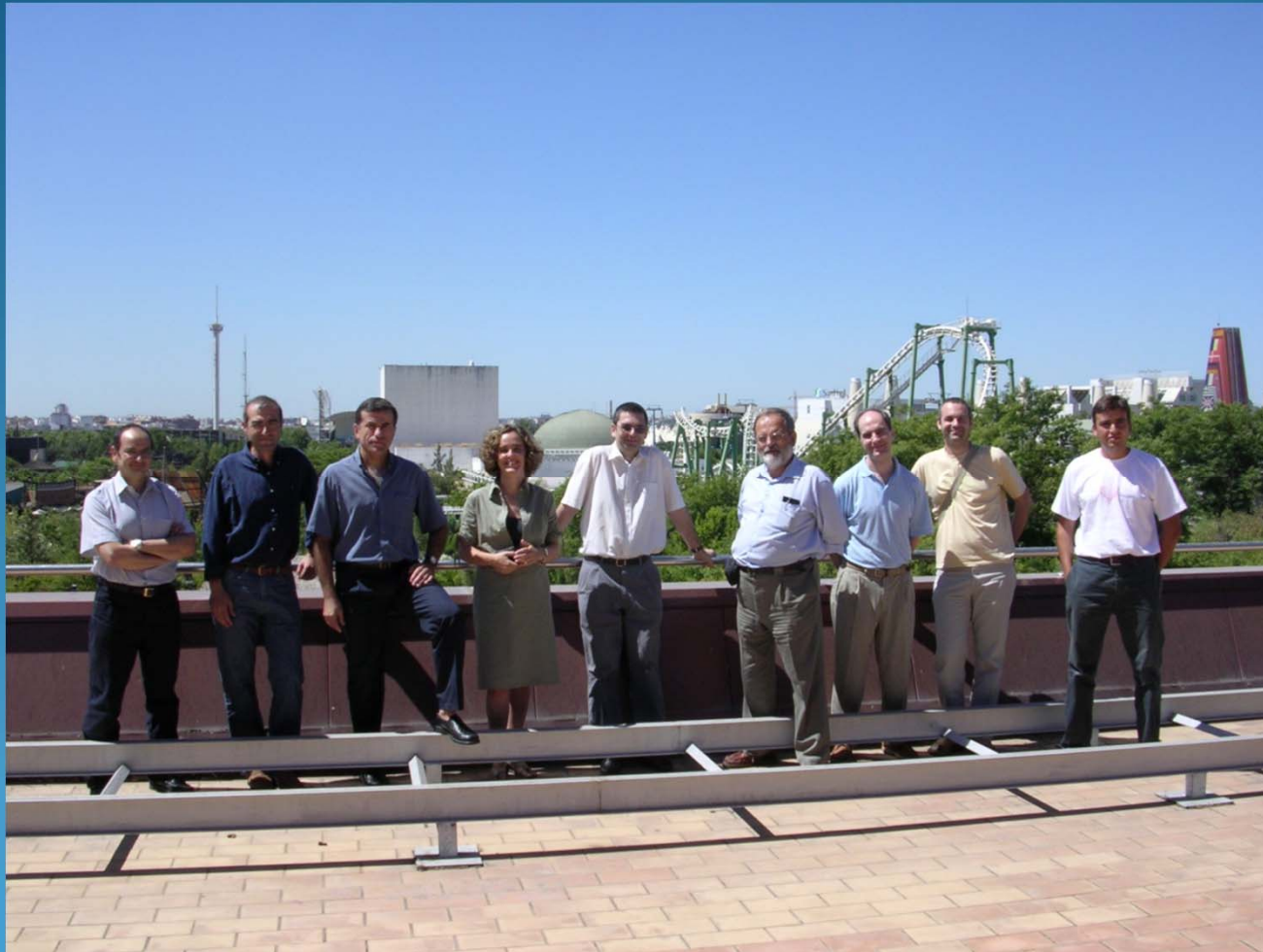
A creative way of decoupling the local substation estimation from the area-wide estimation, without giving up on other capabilities such as bad data processing and observability analysis. Facilitates very large interconnected networks to be monitored without growing the computational complexity with system size.

Spectrum of Journals

- IEEE Trans. on Power Systems
- IEEE Trans. on Power Delivery
- IEEE Trans. on Circuits and Systems: Analog and Digital Signal Processing
- IEEE Trans. on Energy Conversion
- Computer Applications in Engineering Education
- IEEE Trans. on Smart Grids
- International Journal of Circuit Theory and Applications
- Int. Journal of Electrical Power & Energy Systems
- IEEE Trans. on Power Electronics
- Lecture Notes in Computer Science
- Neurocomputing
- IEE Proceedings on Transmission, Generation and Distribution

Visionary Leader ...

Sevilla group



Power Systems Research Group

Initiates the Power Systems Research Group at University of Seville (1980s)

In two decades the group grows into one of the two most prominent, productive and internationally recognized Spanish teams in the Power Engineering area. It currently includes:

15 Ph.D. teachers

3 Full Professors

10 Research Assistants (Ph.D. students)

Also, he has been serving as the chair of the Department of Electrical Engineering at University of Seville.



Educator ...

a prolific author
a towering mentor



Books

1. *“Electric Energy Systems: Analysis and Operation”*, A. Gomez, A. Conejo, C. Canizares (editors), **CRC Press, 850 pp.**
2. *“Fundamentos de Teoria de Circuitos”*, A. Gomez, J.L. Martinez, J.A. Rosendo, E. Romero, J. Riquelme, **Thomson-Paraninfo, 580 pp., (in Spanish).**
3. *“Teoria de Circuitos: ejercicios de autoevaluacion”*, A. Gomez, J.L. Martinez, J.A. Rosendo, E. Romero, J. Riquelme, **Thomson-Paraninfo, 290 pp., 2005.**
4. *“Power System State Estimation: Theory and Implementation”*, A. Abur, A. Gomez, **Marcel Dekker, 300 pp., 2004.**
5. *“Analisis y Operacion de Sistemas de Energia Electrica”* A. Gomez (leading author and coordinator), **McGraw-Hill, 800 pp., 2002, ISBN 84-481-3592-X (in Spanish).**
6. *“Sistemas Electricos de Potencia. Ejercicios y problemas resueltos”*, A. Gomez, J.L. Martinez, J.A. Rosendo, E. Romero, J. Riquelme, **Prentice Hall, 350 pp., 2002, (in Spanish).**
7. *“Estimacion de Estado y de Parametros en Redes Electricas”*, P. Zarco, A. Gomez, Servicio de publicaciones **Universidad de Sevilla, 200 pp., 1999, (in Spanish).**
8. *“Problemas Resueltos de Teoria de Circuitos”*, A. Gomez, J.A. Olivera, **Paraninfo, 339 pp., 1990, Second Edition: 1994, (in Spanish).**
9. *“Sistemas Electricos de Potencia”*. L.G. Franquelo, A. Gomez. **E.T.S.I.I. de la Universidad de Sevilla, 322 pag., 1984 (in Spanish).**

Major Accomplishments as an Educator

Initiator and Editor of the textbook entitled “*Analysis and Operation of Electric Energy Systems*” (McGraw-Hill, 2002, in Spanish).

This book is co-authored by 18 prominent professors from several countries. [Adopted in Spain as well as Mexico, Chile, Argentina, Colombia, Brazil]. It is also published in English.

He is the Director of the Ph.D. program entitled “*Technical and Economic Management of Generation, Transmission and Distribution Systems*”. This program has been recently awarded the *Quality Distinction* in a nation-wide competitive call organized by the Spanish National Agency for Quality Evaluation.

Three out of the seven Ph.D. theses he has advised in Spain, have been recognized with the “*Doctoral Thesis Extraordinary Award*”, yearly granted by the University of Seville. This is a unique achievement to the best of our records.

PhD Supervision [11 PhDs]

1. *“Control of VSC and power systems with renewable generation”*. by Juan M. Mauricio Ferramola, April 2009.

2. *“Electronic tap changers for power transformers based on switched thyristors”*. by Dario Monroy, April 2007.

3. *“Contributions to the transient analysis of linear time-invariant circuits”*. by Alfonso Bachiller, July 2005 (co-advisor J.A. Rosendo).

4. *“Reactive Power Optimization and Voltage Control of the Algerian Network”*. by M. Khiat, June 2003 (co-advisor: A. Chaker).

5. *“Reduced Substation Models for Generalized State Estimators”*. by A. de la Villa Jaen, June 2001.

6. *“Exploring New Techniques for Static Security Analysis of Transmission Networks”*. by J.M. Riquelme Santos, February 1999.

PhD Supervision ...

7. *“Analysis of Radial and Weakly Meshed Electrical Networks. Alternative Formulations”* by E. Romero Ramos, February 1999.
8. *“DFT Signal Processing with Applications to Digital Protections”*. by J.A. Rosendo Macias, June 1997. Recognized with the “Doctorate Extraordinary Award” by the University of Sevilla.
9. *“Off-Line Estimation of Network Parameters by Means of Recorded Measurements”*. by P.J. Zarco Perinan, May 1997.
10. *“Combining Numerical and Heuristic Techniques for the Control of Voltages and Reactive Power”*. by J.L. Martinez Ramos, December 1994. Recognized with the “Doctorate Extraordinary Award” by the University of Sevilla.
11. *“Inclusion of Line Current Measurements in State Estimation”*. by J.M. Ruiz Munoz, June 1990. Recognized with the “Doctorate Extraordinary Award” by the University of Sevilla.

Videos

“Fundamentals of Electrical Engineering” (in Spanish).

J. Riquelme, E. Romero, A. Gomez.

Secretariado de Recursos Audiovisuales, Universidad de Sevilla, 2000.

“Circuit Theory Laboratory Experiments” (in Spanish).

J. Riquelme, E. Romero, A. Gomez.

Secretariado de Recursos Audiovisuales, Universidad de Sevilla, 2000.

Recognition...

well recognized technical leader



Honors and Awards

2008-2012: Included in a list of 25 outstanding researchers among a total of over 4000 eligible people.

2007: NOVARE prize (0.5Meuros), awarded by Endesa, in the category “Smart Distribution Grids”, to the project entitled SmarTie. Over 40 proposals from 10 countries were submitted.

2006: Special Mention in NOVARE prize, awarded by Endesa, in the category “Quality and Reliability of Service in Distribution Networks”.

2005: “City of Seville” award to a research project on energy topics.

2005: Elected to *Fellow member of the IEEE “for contributions to power system analysis and operation”*.

2003-2009: The Ph.D. program he is chairing, entitled “Technical and Economic Management of Generation, Transmission and Distribution Systems” has been awarded every consecutive year the *Quality Distinction by the Spanish National Agency for Quality Evaluation*.

Honors and Awards ...

1990, 1994 and 1997: Three of the Ph.D. Theses he has advised have been recognized with the “**Doctoral Thesis Extraordinary Award**” yearly granted by the University of Sevilla.

1995: Nominated to the “**Best Spanish Initiative in Information Technologies Award**”, by the PCWEEK magazine, for the project “**Expert System for VAR/Voltage Control and Optimization (SETRE)**”.

1985: His doctoral thesis was recognized by the “*City of Seville Prize*” as the best doctoral thesis.

1983 - 85: Awarded a grant by the Andalusian Professional Engineering Association to carry out his doctoral thesis.

1983: Awarded the *Real Maestranza de Caballeria de Sevilla Prize given to the best student* obtaining the Industrial Engineering degree.

Professional Activities

Chair of the Spanish IEEE/PES Chapter.

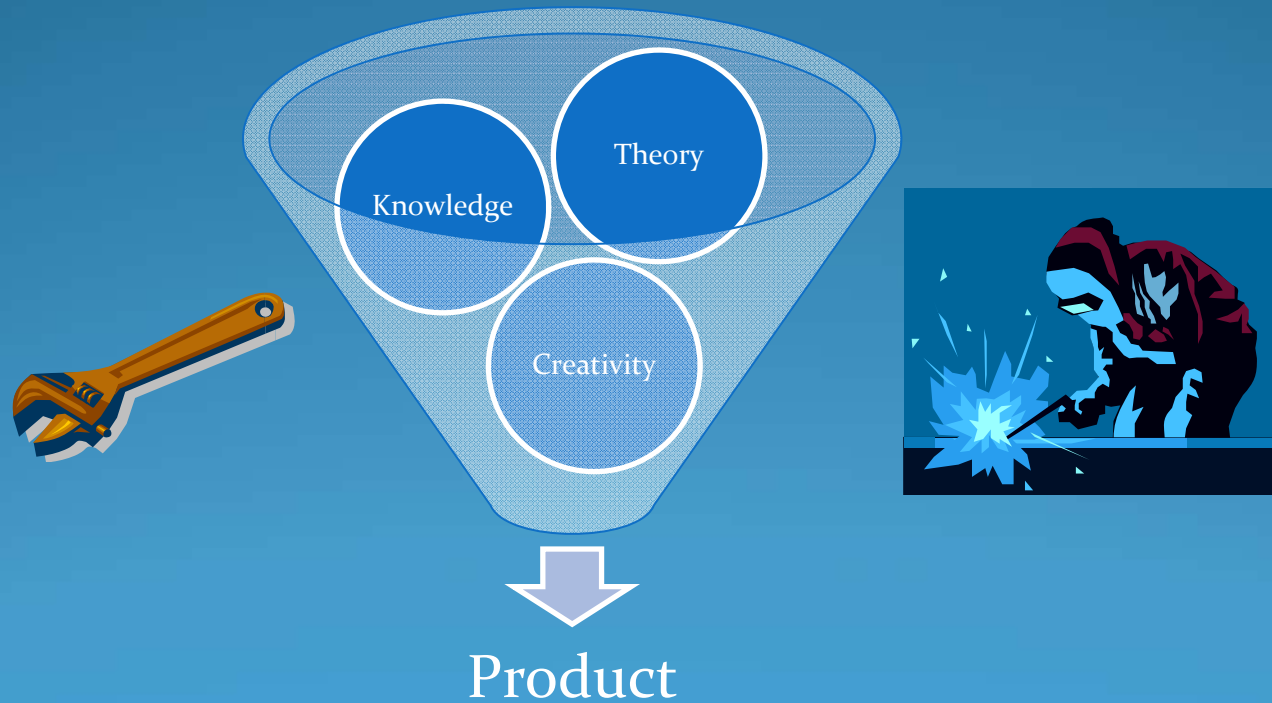
Member of numerous IEEE/PES committees and working groups.

Member of the Technical Program Committee at most relevant International Conferences in the Power Engineering field.

Chaired the Local Organizing Committee of the 13th Power Systems Computation Conference (2002).

Engineer ...

agent of technology transfer



Engineered Products

Two State Estimators developed for:

- Endesa (1991-93) and
- Union Fenosa (2002).

He supervised and coordinated the projects, undertaken in cooperation with software engineering companies. To the best of our knowledge, these are the only two State Estimators worldwide extensively using Ampere measurements.

Expert System for power loss minimization

(through reactive power and voltage control)

This software has been used for several years by Red Eléctrica, the Spanish ISO, in its central and regional control centers, as well as by Endesa, the largest Spanish utility, which has tailored the system to its distribution network.

Impact on the State of the Art

Extremely fast and numerically robust moving-window Discrete Fourier Transform (DFT) algorithms to be embedded in new generations of digital protection and measurement devices.

Some of these algorithms were tested on a prototype digital differential relay for three-winding transformers.

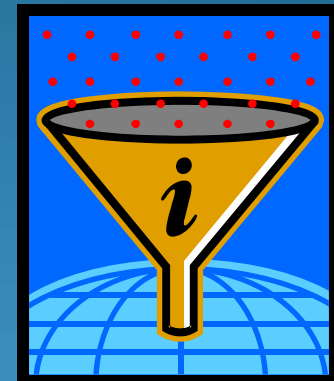
These devices were later manufactured and sold by Artech Hermanos, the Spanish leading company in protection equipment.

Their high computational efficiency is frequently cited by journals specializing in various other Electrical Engineering areas such as image processing, electronics, etc.

Node Ordering Methods are cited and described in several advanced monographs, book chapters, and are implemented in modern EMS software tools.

Collaborator ...

fun to work with



Books, Research, and more ...

My collaborations since 1992:

Spent the summers of 1992 (Expo '92) and 1996 in University of Sevilla

Co-authored a textbook on:

Power System State Estimation: Theory and Implementation (2003)

Co-presenters at several Short Courses / Tutorials

Co-authored 9 papers, currently working on 2

The person ...

art & music

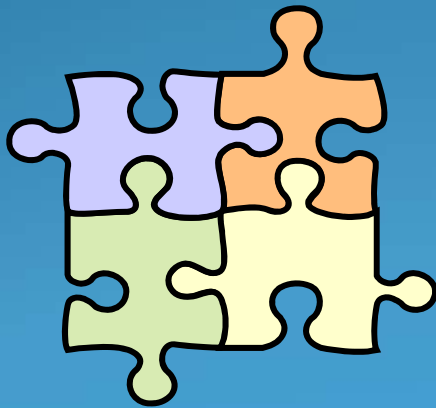


Granddad's Portrait
By Antonio
The Painter

Antonio
The Guitar Player
and
The Singer

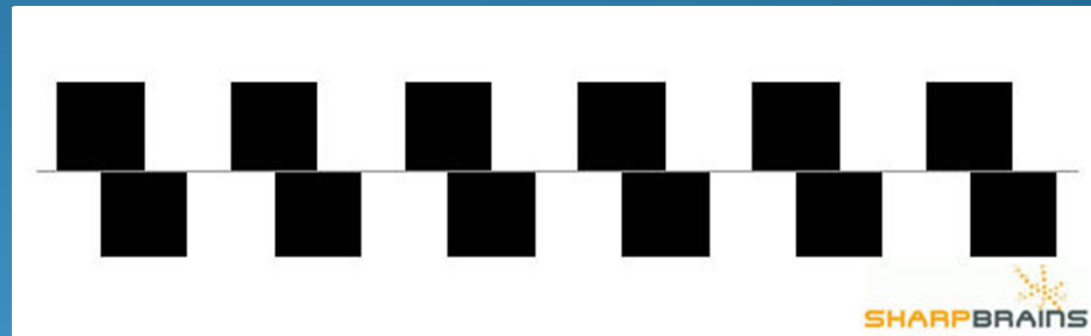
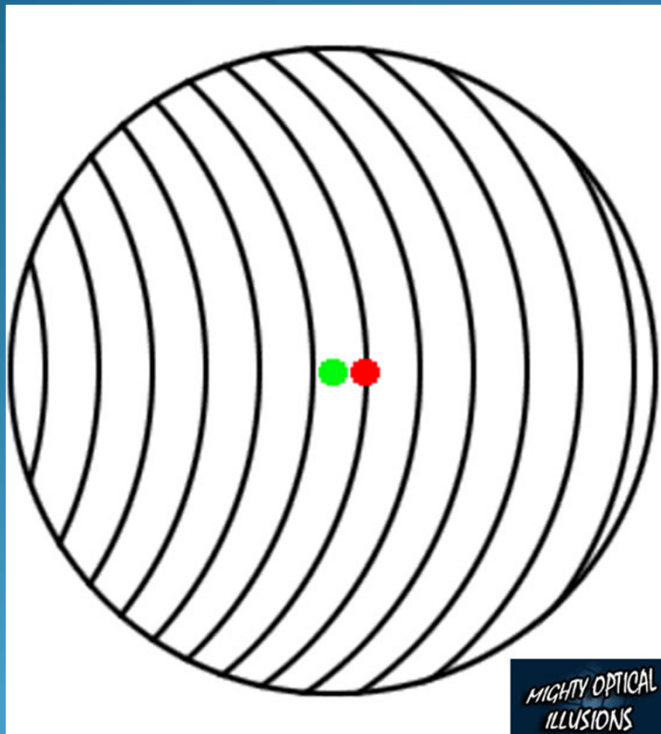
simple solutions to complex problems...

There's nothing remarkable about it.
All one has to do is hit the right keys at the right time
and the instrument plays itself.



~ Johann Sebastian Bach

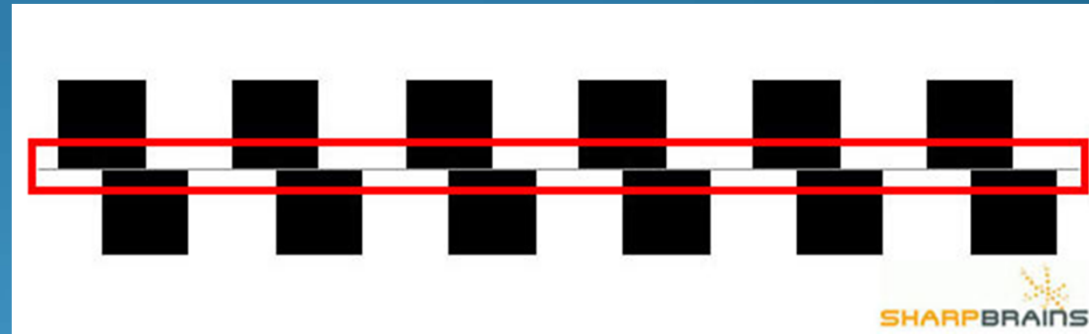
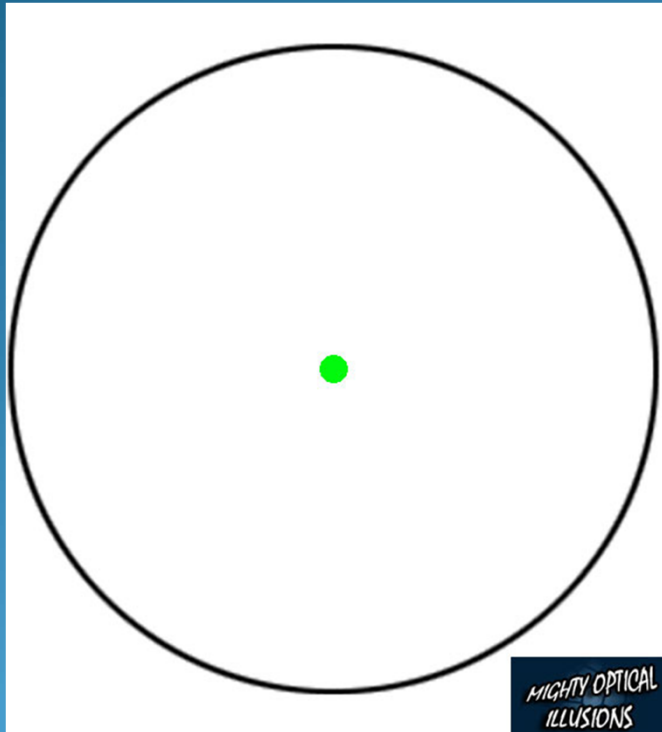
finding the counter intuitive solutions...



IS THIS LINE GOING UP ?
OR HORIZONTAL ?

WHICH ONE IS THE CENTER?
RED or GREEN

finding the counter intuitive solutions...



and the award goes to ...

- Clever application of algebra and numerical analysis to power system problems
- Hard and meticulous worker
- Producer of engineering solutions that have immediate practical applications
- Prolific writer of articles and books
- Technical leader and mentor
- Resourceful, reliable, honest and generous
- Wide variety of research and engineering interests

.....a modern day LEONARDO !