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How to write a basic technical paper?

Eszter Lukács
IEEE Client Services Manager
Europe

About the IEEE

- A not-for-profit society
- World's largest technical membership association with over 415,000 members in 160 countries
- Five core areas of activity
 - Publishing
 - Conferences
 - Standards
 - Membership
 - E-learning

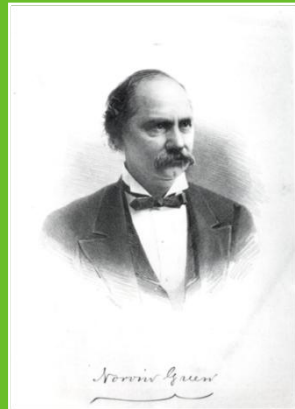


IEEE's Mission

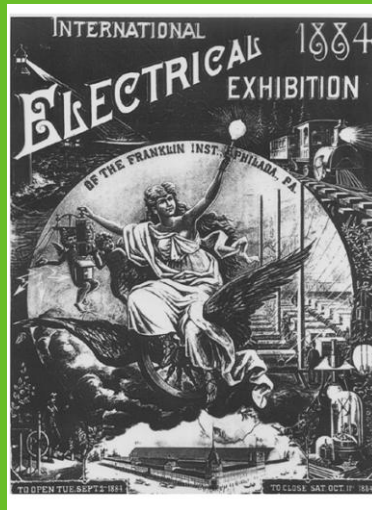
IEEE's core purpose is to foster technological innovation and excellence for the benefit of humanity

1884: The American Institute of Electrical Engineers is founded

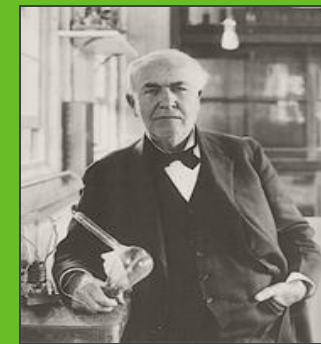
A small group of individuals met in New York and founded the AIEE to advance the new field and represent the US at the 1884 International Electrical Exhibition in Philadelphia.



Norvin Green,
President
of Western Union
Telegraph and first
president of the AIEE



Program of the 1884
International Electrical
Exhibition, Franklin
Institute, Philadelphia



Thomas Edison, one
of the founders of the
AIEE

1912: The Institute of Radio Engineers is founded

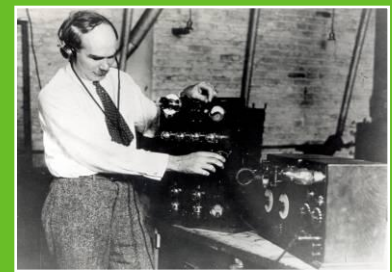
Radio, a new electrical technology, arose in the first decade of the twentieth century. With the new industry came a new society, IRE, modeled on the AIEE, but devoted to radio, and later increasingly to electronics.



1901
Guglielmo Marconi and **George Kemp** with equipment used in transatlantic wireless telegraphy



1912
Radio telegraph operators' communications with the sinking Titanic demonstrated the power of radio



1922
Triode vacuum tube inventor **Lee de Forest** with a radio

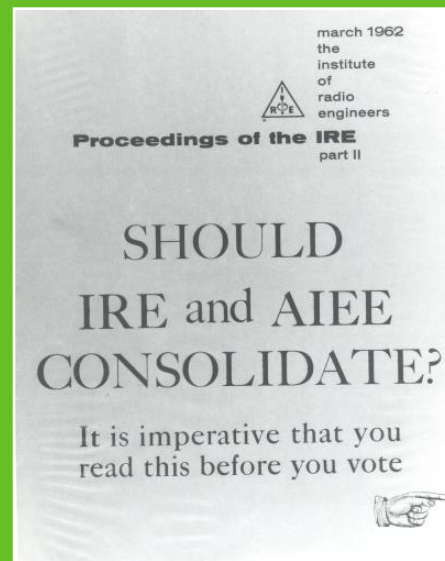
AIEE + IRE = IEEE

The idea that there should be one organization for all electrical engineers was an old one, and became more powerful as the profession expanded beyond its separate roots in power and radio. In 1962, the boards and memberships of the two institutes agreed to merge. On January 1, 1963, the Institute of Electrical and Electronic Engineers was born with 150,000 members.

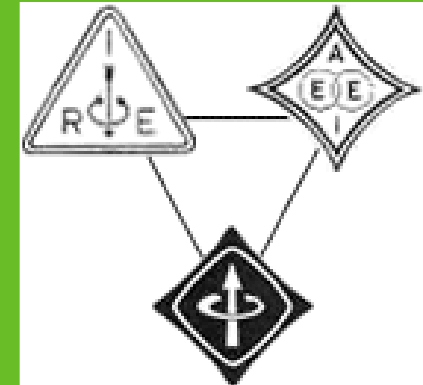


1962

Symposium on the proposed merger, IRE National Convention



Special merger issue of the Proceedings of the IRE



The badge of the new IEEE combined the right hand rule from the IRE with the kite from the AIEE

Career Development Resources and Opportunities for student members

IEEE Job Sites and Career Alerts

- ❑ Locate career opportunities easily and confidentially
- ❑ Weekly email newsletter containing career advice

IEEE Xplore

- ❑ Learn to use IEEE Xplore for company, career, and job related searches

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- ❑ Networking and Presenting Opportunities
- ❑ Student Paper Contests

Education Partners Program (EPP-IEEE)



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Triletron

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SAIC

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CLOUD COMPUTING

CYBER SECURITY ELECTROMAGNETICS  **IEEE**

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IEEE Communications Society

IEEE Components, Packaging, and Manufacturing Technology Society

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IEEE Consumer Electronics Society

IEEE Control Systems Society

IEEE Dielectrics and Electrical Insulation Society

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IEEE Engineering in Medicine and Biology Society

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IEEE Industry Applications Society

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IEEE Instrumentation and Measurement Society

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IEEE Nuclear and Plasma Sciences Society

IEEE Oceanic Engineering Society

IEEE Photonics Society

IEEE Power Electronics Society

IEEE Power & Energy Society

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IEEE Robotics and Automation Society

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IEEE Solid-State Circuits Society

IEEE Systems, Man, and Cybernetics Society

IEEE Ultrasonics, Ferroelectrics, and Frequency Control Society

IEEE Vehicular Technology Society



IEEE quality makes an impact

Thomson Reuters Journal Citation Reports® by Impact Factor

IEEE publishes:

19 of the top 20 journals in Electrical and Electronic Engineering

18 of the top 20 journals in Telecommunications

7 of the top 10 journals in Automation & Control Systems

6 of the top 10 journals in Computer Science, Hardware & Architecture

4 of the top 5 journals in Cybernetics

3 of the top 5 journals in Artificial Intelligence

2 of the top 5 journals in Robotics

The Thomson Reuters Journal Citation Reports presents quantifiable statistical data that provides a systematic, objective way to evaluate the world's leading journals.

Based on the 2013 study released June 2014

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IEEE quality makes an impact

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- # 1 in Industrial Engineering
- # 1 in Manufacturing Engineering
- # 1 in Robotics
- # 1 in Telecommunications
- # 2 in Aerospace
- # 2 in Information Systems
- # 2 in Imaging Science



The Thomson Reuters Journal Citation Reports presents quantifiable statistical data that provides a systematic, objective way to evaluate the world's leading journals.

Based on the 2013 study released June 2014

IEEE Leads US Patent Citations

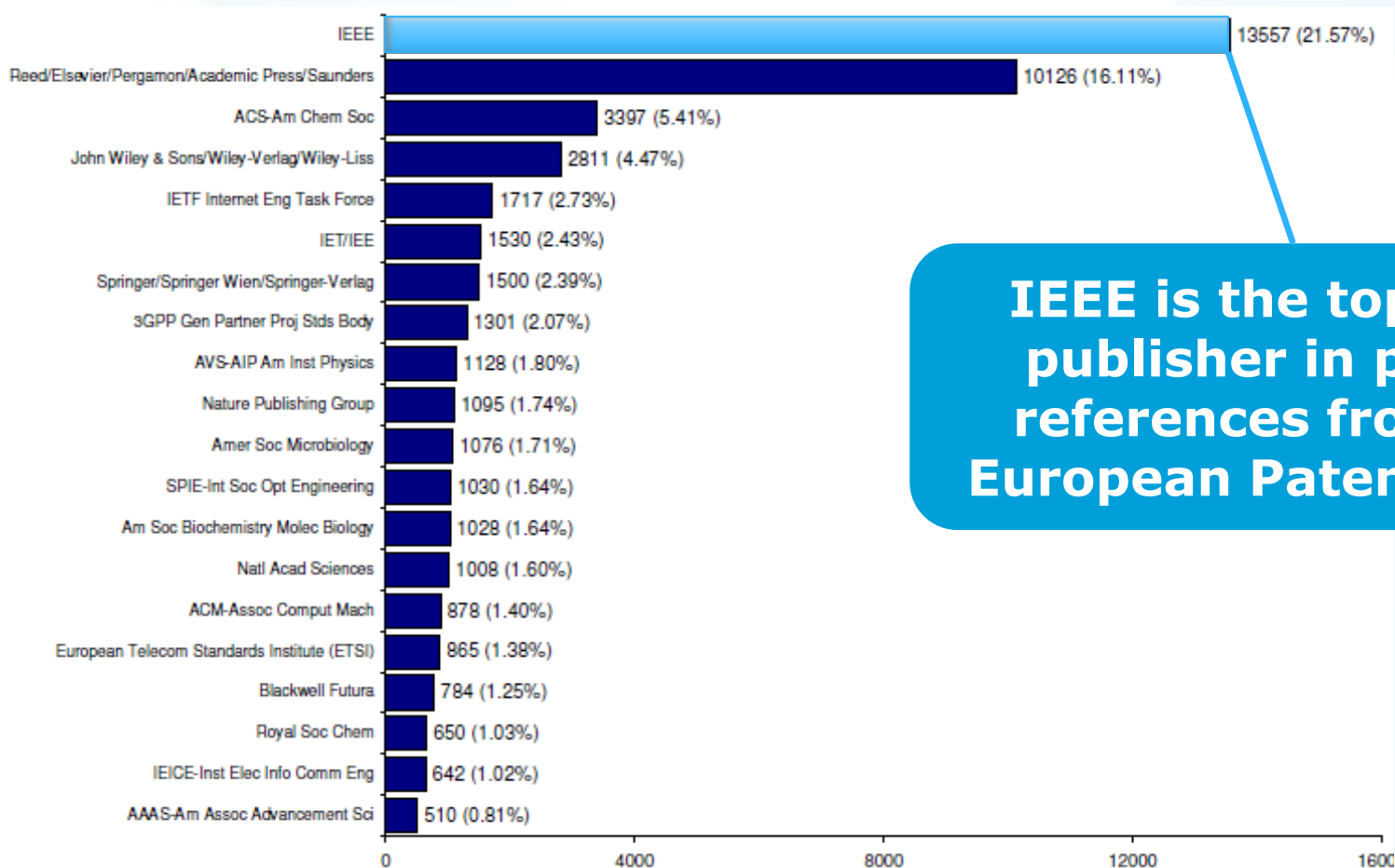
Top 20 Publishers Referenced Most Frequently by Top 40 Patenting Organizations



IEEE is cited over 3x more often than any other publisher

IEEE Leads European Patent Citations

Top 20 Publishers Referenced Most Frequently in EPO Patents by Top 25 Patenting Organizations



IEEE is the top cited publisher in patent references from the European Patent Office

Source: 1790 Analytics LLC 2012, Science References from 1997-2011

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- **NEW! Bell Labs Technical Journal (BLTJ) back to 1922**
- Inspec index records for all articles
- Backfile to 1988, select legacy data back to 1872

New IEEE Journals Coming in 2015

- *IEEE Trans. on **Big Data***
- *IEEE Trans. on **Transportation Electrification***
- *IEEE Trans. on **Cognitive Communications and Networking***
- *IEEE Trans. on **Computational Imaging***
- *IEEE Trans. on **Molecular, Biological, and Multi-Scale Communications***
- *IEEE Trans. on **Multi-Scale Computing Systems***
- *IEEE Trans. on **Signal and Information Processing over Networks***
- *IEEE **Systems, Man, and Cybernetics Magazine***



Examples of New IEEE Conferences in 2014



- **Internet of Things** (WF-IoT), 2014 IEEE World Forum on
- **Humanitarian Technology** Conference, (IHTC), 2014 IEEE Canada International
- Aerospace Electronics and Remote Sensing Technology (ICARES), 2014 IEEE International Conference on
- Antenna Measurements & Applications (CAMA), 2014 IEEE Conference on
- Consumer Electronics, Taiwan (ICCE-TW), 2014 IEEE International Conference on
- Energy Conversion (CENCON), 2014 IEEE Conference on
- Ethics in Science, Technology and Engineering, 2014 IEEE International Symposium on
- **Transportation Electrification** Asia-Pacific (ITEC Asia-Pacific), 2014 IEEE Conference and Expo
- **Intelligent Energy** and Power Systems (IEPS), 2014 IEEE International Conference on
- Quantum Optics Workshop (QOW), 2014
- Sensor Systems for a Changing Ocean (SSCO), 2014 IEEE
- Wireless and Mobile, 2014 IEEE Asia Pacific Conference on
- Industrial Engineering and Information Technology (IEIT), 2014 International Conference on
- Guidance, Navigation and Control Conference (CGNCC), 2014 IEEE Chinese

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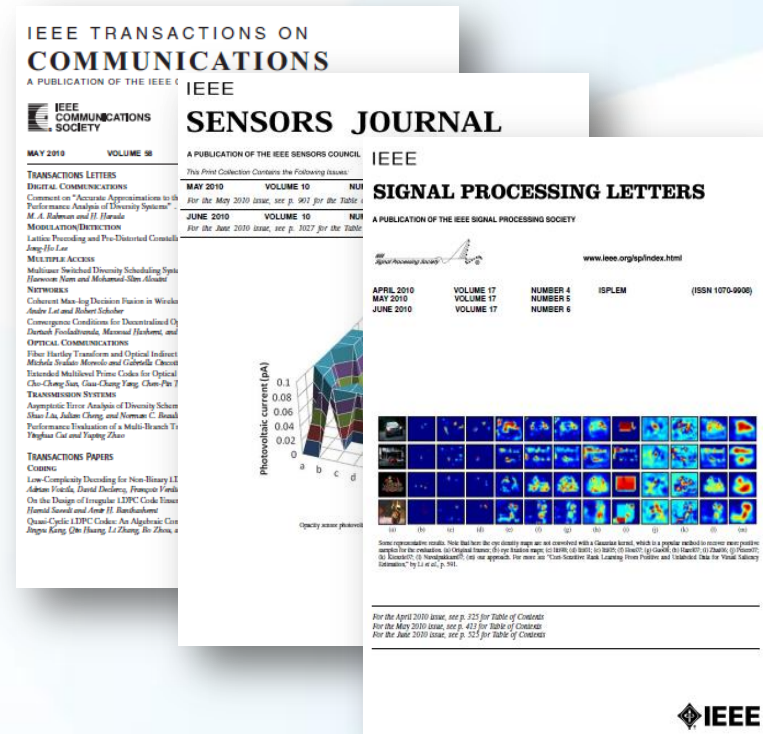
Publish

IEEE journal or IEEE conference?

- A **journal article** is a fully developed presentation of your work and its final findings
 - Original research results presented
 - Clear conclusions are made and supported by the data
- A **conference article** can be written while research is ongoing
 - Can present preliminary results or highlight recent work
 - Gain informal feedback to use in your research
- Conference articles are typically shorter than journal articles, with less detail and fewer references

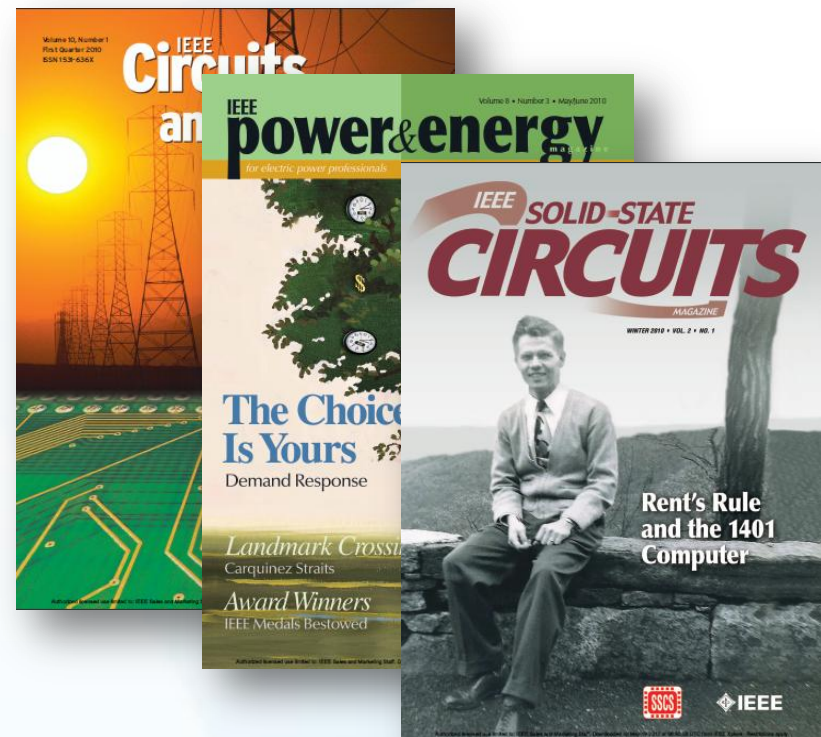
Journals

- Journals, Transactions, and Letters are the primary means for publishing technical papers concerning original work in IEEE fields of interest.
 - The primary purpose of Journals, Transactions, and Letters is to disclose and provide a permanent archival record of original technical work that advances the state of the art or provides novel insights.
 - Letters are for the publication of brief papers, usually three to four pages in length.



Magazines

- Magazines are characterized by regular and continuing issues with significant technical content in addition to general news and regular columns
 - IEEE Communications Magazine
 - IEEE Microwave Magazine
 - IEEE Signal Processing Magazine
 - IEEE Instrumentation & Measurement Magazine
 -



MTT Journals & Magazines



	Transactions	Letters	Magazine
New Research Article	YES (6 pages, over-length charge)	YES (3 pages)	NO
Tutorial Article	YES (at expert level)	NO	YES (Fundamental - Intermediate)
Application Note	NO	NO	YES
Review Article	YES (at expert level)	NO	YES (Fundamental - Intermediate)

- **Research Article:** Papers in the journals use the IEEE standard format and must include a Title, Abstract, Introduction, Technical Content, Conclusions, and References. The transactions also include the author biographies.
- **Tutorial:** Unique presentation of known material. Valuable methodologies, exhaustive references
- **Application Note:** Describe current application of technology: circuits, systems, models, concepts.
- **Review:** Historical account of field, exhaustive references, explanation of state-of-the-art, indications of future research

Audience

What IEEE editors and reviewers are looking for

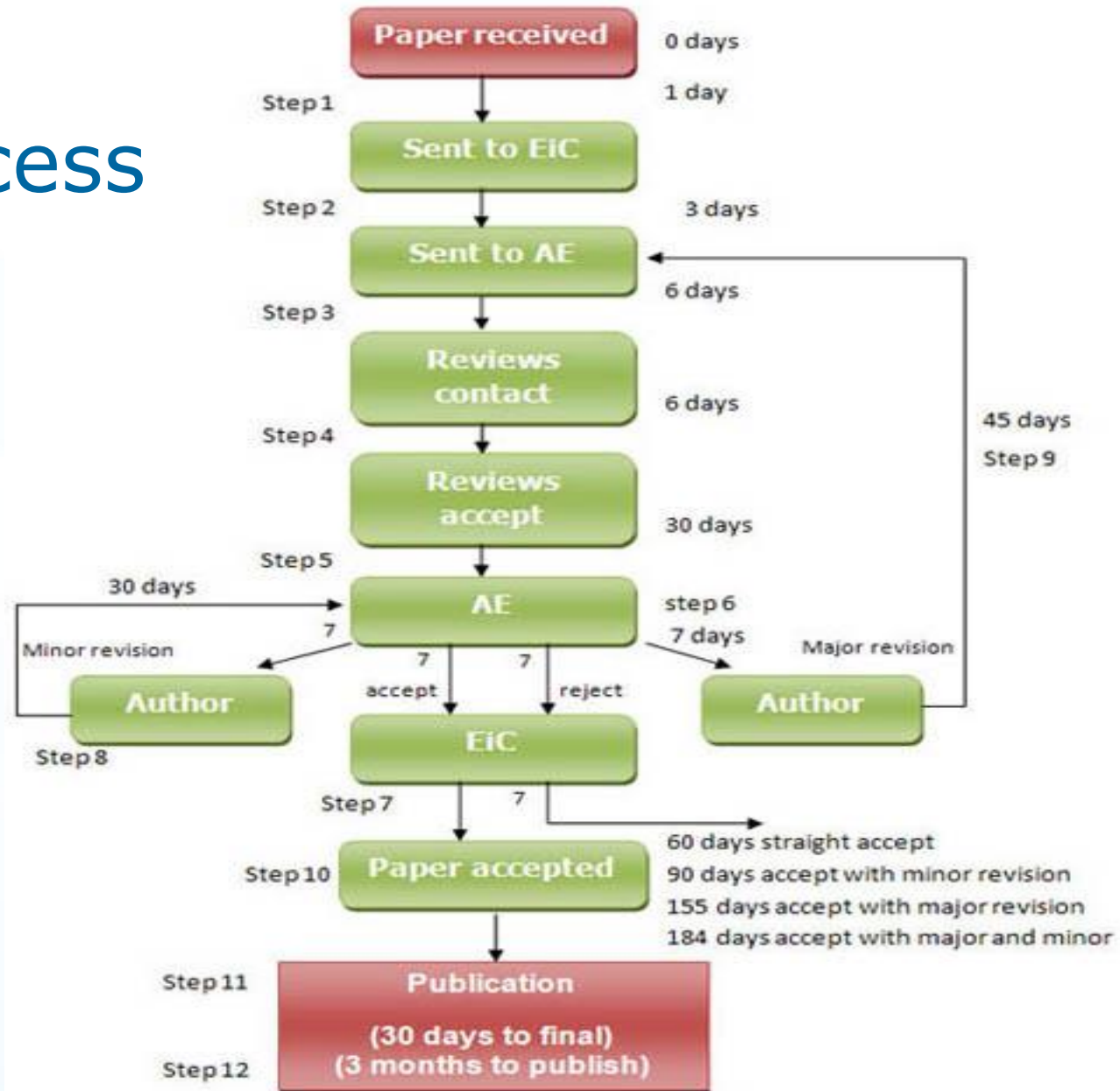
- Content that is **appropriate, in scope and level, for the journal**
- Clearly written **original material that addresses a new and important problem**
- Valid methods and rationale
- Conclusions that make sense
- Illustrations, tables and graphs that support the text
- References that are current and relevant to the subject

Audience

Why IEEE editors and reviewers reject papers

- The content is **not a good fit for the publication**
- There are serious scientific flaws:
 - Inconclusive results or incorrect interpretation
 - Fraudulent research
- It is poorly written
- It does **not address a big enough problem** or advance the scientific field
- The work **was previously published**
- The **quality is not good enough for the journal**
- **Reviewers have misunderstood the article**

Review Review Process



e.g. IEEE
Transactions on
Information
Technology in
Biomedicine

Review

Possible review decisions

- **ACCEPT:** Congratulations! The paper now is entered into a production process.
- **ACCEPT WITH MINOR CORRECTIONS:** One or more of the referees have made suggestions for improvement.
- **RESUBMIT:** The paper has major deficiencies that could be repaired by the author.
- **REJECT:** If you have a rejection from a top publication, you can try submitting the paper to a less-selective publication.



Author Processing

Once accepted...

- Bills are sent to the author, if open access.
- Article production is initiated.
- Articles are posted online and included in the print version, if available.



Structure

Paper Structure

Elements of a manuscript

Title

Abstract

Keywords

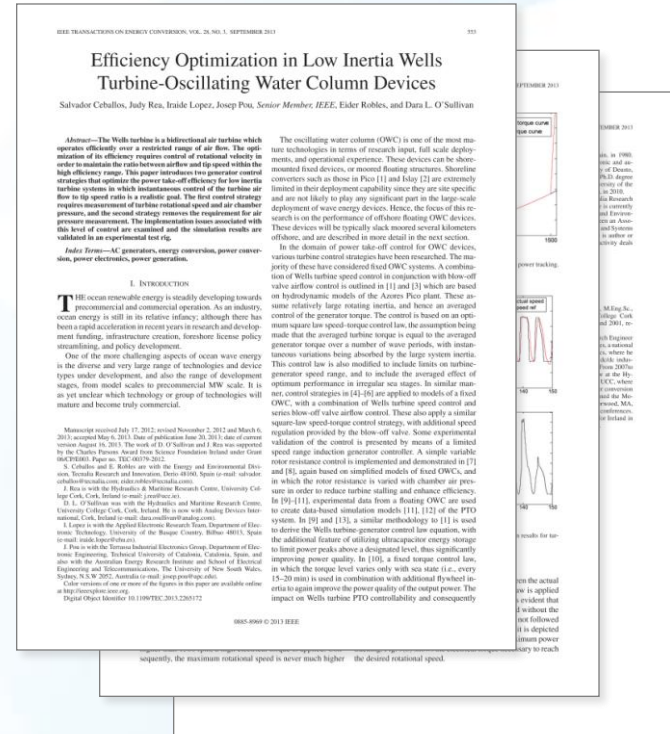
Introduction

Methodology

Results/Discussions/Findings

Conclusion

References



sequently, the maximum rotational speed is never much higher than the desired rotational speed.

Paper Structure

Title

An effective title should...

- Answer the reader's question:
"Is this article relevant to me?"
- Grab the reader's attention
- Describe the content of a paper using the fewest possible words
 - Is crisp, concise
 - Uses keywords
 - Avoids jargon

Good
Title

VS.

Bad
Title

Paper Structure

Good vs. Bad Title

A Human Expert-based Approach to Electrical Peak Demand Management

VS

A better approach of managing environmental and energy sustainability via a study of different methods of electric load forecasting

Paper Structure

Good vs. Better Title

An Investigation into the Effects of Residential Air-Conditioning Maintenance in Reducing the Demand for Electrical Energy

VS

"Role of Air-Conditioning Maintenance on Electric Power Demand"

Paper Structure

Abstract

A “stand alone” condensed version of the article

- No more than 250 words; written in the past tense
- Uses keywords and index terms

Why you did it

What you did

Why they're useful & important & move the field forward

How the results were useful, important & move the field forward

Good vs. Bad Abstract

The objective of this paper was to propose a human expert-based approach to electrical peak demand management. The proposed approach helped to allocate demand curtailments (MW) among distribution substations (DS) or feeders in an electric utility service area based on requirements of the central load dispatch center. Demand curtailment allocation was quantified taking into account demand response (DR) potential and load curtailment priority of each DS, which can be determined using DS loading level, capacity of each DS, customer types (residential/commercial) and load categories (deployable, interruptible or critical). Analytic Hierarchy Process (AHP) was used to model a complex decision-making process according to both expert inputs and objective parameters. Simulation case studies were conducted to demonstrate how the proposed approach can be implemented to perform DR using real-world data from an electric utility. Simulation results demonstrated that the proposed approach is capable of achieving realistic demand curtailment allocations among different DSs to meet the peak load reduction requirements at the utility level.

Vs

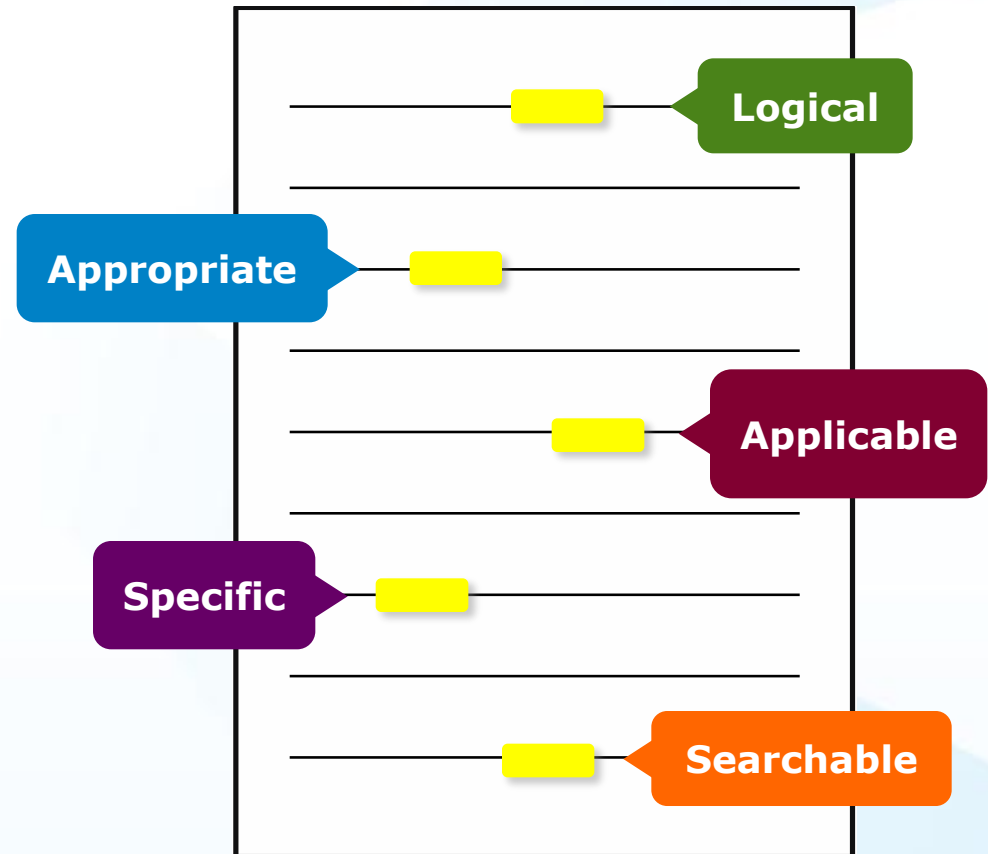
This paper presents and assesses a framework for an engineering capstone design program. **We explain** how student preparation, project selection, and instructor mentorship are the three key elements that must be addressed before the capstone experience is ready for the students. **Next, we describe** a way to administer and execute the capstone design experience including design workshops and lead engineers. **We describe the importance** in assessing the capstone design experience and report recent assessment results of our framework. **We comment** specifically on what students thought were the most important aspects of their experience in engineering capstone design and provide quantitative insight into what parts of the framework are most important.

First person, present tense

No actual results, only describes the organization of the paper

Paper Structure Keywords

Use in the Title and
Abstract for enhanced
Search Engine Optimization



Paper Structure

Introduction

- A description of the problem you researched
- It should move step by step through:

Generally known
information
about the topic

Prior studies'
historical
context to your
research

Your hypothesis
and an overview
of the results

How the article
is organized

- The introduction should be:
 - Specific, not too broad or vague
 - About 2 pages
 - Written in the present tense

Paper Structure

Methodology

- Problem formulation and the processes used to solve the problem, prove or disprove the hypothesis
- Use illustrations to clarify ideas, support conclusions:

Tables

Present representative data or when exact values are important to show



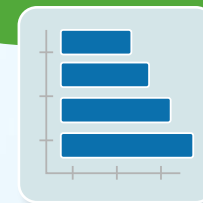
Figures

Quickly show ideas/conclusions that would require detailed explanations



Graphs

Show relationships between data points or trends in data



Paper Structure

Results/discussion

Demonstrate that you solved the problem or made significant advances

Results: Summarized Data

- Should be clear and concise
- Use figures or tables with narrative to illustrate findings

Discussion: Interprets the Results

- Why your research offers a new solution
- Acknowledge any limitations

Discussion

Results

the SC algorithm over the whole range of w values increase to 3–4 K, except for the TIGR₁₊₁₁ database, with an RMSE of 2 K. This last result is explained by the w distribution, which is biased toward low values of w in this database. When only atmospheric profiles with w values lower than $3 \text{ g} \cdot \text{cm}^{-2}$ are selected, the SC algorithm provides RMSEs around 1.5 K, with almost equal values of bias and standard deviation, around 1 K in both cases (with a negative bias, thus the SC underestimates the LST). In contrast, when only w values higher than $3 \text{ g} \cdot \text{cm}^{-2}$ are considered, the SC algorithm provides RMSEs higher than 5 K. In these cases, it is preferable to calculate the atmospheric functions of the SC algorithm directly from (3) rather than approximating them by a polynomial fit approach as given by (4).

V. DISCUSSION AND CONCLUSION

The two Landsat-8 TIR bands allow the intercomparison of two LST retrieval methods based on different physical assumptions, such as the SC (only one TIR band required) algorithms (two TIR bands required). Direct inversion of the transfer equation, which can be considered the ground truth, is assumed to be a “ground-truth” condition that the information about the r and L_s is accurate enough. The SC algorithm in this letter is a combination of the previous SC algorithm developed for Landsat-4 and Landsat-5 TM sensors, and the ETM+ sensor on board the Landsat-7 platform [9], and it could be used to generate consistent LST products from the historical Landsat data using a single algorithm. An advantage of the SC algorithm is that, apart from surface emissivity, only water vapor content is required as input. However, it is expected that errors on LST become unacceptable for high water vapor contents (e.g., $> 3 \text{ g} \cdot \text{cm}^{-2}$). This problem can be partly solved by computing the atmospheric functions directly from r , L_s , and L_t values (see [5]), or also by including air temperature as input [15]. A main advantage of the SW algorithm is that it performs well over global conditions and, thus, a wide range of water vapor values; and that it only requires water vapor as input (apart from surface emissivity at the two TIR bands). However, the SW algorithm can be only applied to the new Landsat-8 TIRS data, since previous TM/ETM sensors only had one TIR band.

The LST algorithms presented in this letter were tested with simulated data sets obtained for a variety of global atmospheric conditions and surface emissivities. The results showed RMSE values of typically less than 1.5 K, although for the SC algorithm, this accuracy is only achieved for w values below $3 \text{ g} \cdot \text{cm}^{-2}$. Algorithm testing also showed that the SW errors are lower than the SC errors for increasing water vapor, and vice versa, as demonstrated in the simulation study presented in Sobrino and Jimenez-Munoz [18]. Although an extensive validation exercise from *in situ* measurements is required to assess the performance of the two LST algorithms, the results obtained for the simulated data, the sensitivity analysis, as well as the previous findings for algorithms with the same mathematical structure give confidence in the algorithm accuracies estimated here.

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Paper Structure

Conclusion

- Explain what the research has achieved
 - As it relates to the problem stated in the Introduction
 - Revisit the key points in each section
 - Include a summary of the main findings, important conclusions and implications for the field
- Provide benefits and shortcomings of:
 - The solution presented
 - Your research and methodology
- Suggest future areas for research



Paper Structure

References

- Support and validate the hypothesis your research proves, disproves or resolves
- There is no limit to the number of references
 - But use only those that directly support our work
- Ensure proper author attribution
 - Author name, *article title*, publication name, publisher, year published, volume, chapter and page number
 - IEEE journals generally follow a citation numbering system

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We then have

$$\begin{aligned} (P_1^{h+} + P_1^{h-})^2 &= (P_1^{h+} - P_1^{h-})^2 + 4P_1^{h+}P_1^{h-} \\ &< (\hat{P}_1^{h+} - \hat{P}_1^{h-})^2 + 4\hat{P}_1^{h+}\hat{P}_1^{h-} \\ &= (\hat{P}_1^{h+} + \hat{P}_1^{h-})^2 \end{aligned} \quad (32)$$

Since $P_1^{h+} - P_1^{h-} = \hat{P}_1^{h+} - \hat{P}_1^{h-}$, we then have $P_1^{h+} < P_1^{h+}$, and $P_1^{h-} < P_1^{h-}$. Because the operational cost is an increasing function of $\{P_1^{h+}, P_1^{h-}\}$, we obtain that

$$c_{0/1}(P_1^{h+}, P_1^{h-}) < c_{0/1}(\hat{P}_1^{h+}, \hat{P}_1^{h-}). \quad (33)$$

Therefore the optimal pair $\{P_1^{h+}, P_1^{h-}\}$ cannot satisfy that $P_1^{h+}P_1^{h-} = 0$, i.e., only one of P_1^{h+}, P_1^{h-} can be non-zero. ■

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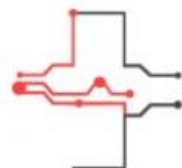


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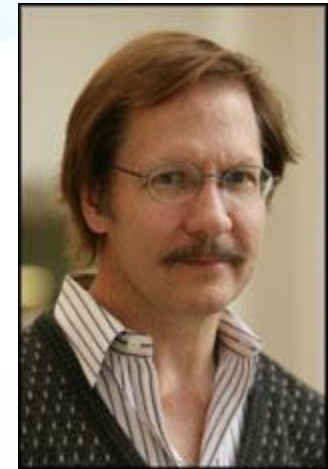
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