How to Write an Effective Technical Paper

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President, IEEE Power & Energy Society 2018 & 2019

Professor, ECE Department, Virginia Tech, USA

Invited Talk, IEEE PES Student Chapter

Georgia Tech, 28 January 2021

Webinar Speaker,

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Professor and Director
Virginia Tech Advanced Research Institute

Education

Ph.D., Electrical Engineering, Virginia Polytechnic Institute and State University, 1978.
M.S., Electrical Sciences, State University of New York at Stony Brook, 1975.
B.Sc., Electrical Engineering, Bangladesh University of Engineering and Technology, Dhaka, 1972

Professional Society Activities

- IEEE Member since 1975, Fellow 1998, Life Fellow 2014
- President, IEEE PES, 2018-2019
- Vice president, Publications, IEEE PES, 2001-2003, 2012-2013
- Vice President, Publications, IEEE, 2006
- Editor-in-Chief, IEEE Transactions on Sustainable Energy, 2010-2012
- Editor-in-Chief, IEEE Electrifications Magazine, 2013-2014
- Launched, the IEEE Power & Energy Technology Systems Journal (Open Access), 2014

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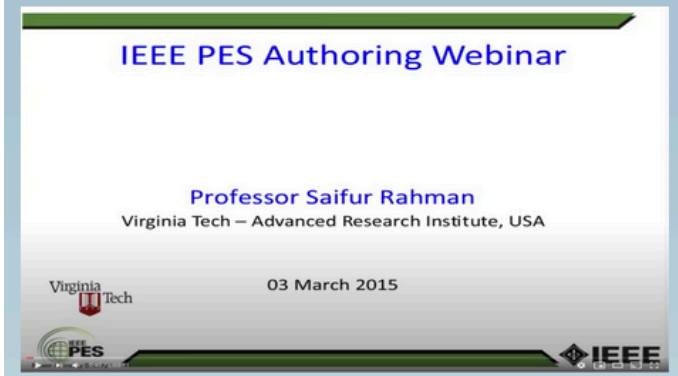
Candidate for IEEE President-Elect 2021

IEEE Related Media



Audience

Audience

Basic Questions

1. Are you writing this paper for the sake of writing a paper?

2. Or do you want to show how others can benefit from your work?

Audience

Scientific research publishing

- Who writes scientific papers?
  - Engineers, scientists, educators and researchers from:
    - Corporations
    - Academia
    - Government
  - Students typically write and present conference papers before submitting journal articles

Audience

What IEEE editors and reviewers are looking for

- Content that is appropriate, in scope and level
- Clearly written original material that addresses a new and important problem
- Extension of previously published work
- Valid methods and rationale
- Illustrations, tables and graphs that support the text
- References that are current and relevant to the subject

Audience

How does the review process work?

- Editor-in-Chief gets the paper after it goes through content match check (iAuthenticate) and “banned author” check
- If the paper is in scope for the journal, it is assigned to an editor (associate editor)
- Editor assigns the paper to five or more reviewers
- Reviewers send their comments back to the editor
- Editor makes a recommendation to the EIC as follows:
  - Accept
  - Revise & Resubmit
  - Reject
- The EIC makes the final decision and informs the corresponding author

Audience

Why IEEE editors and reviewers reject papers

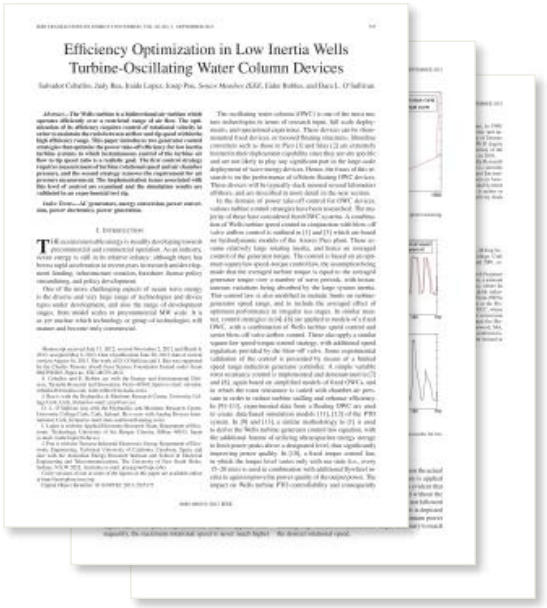
- The content is not a good fit for the publication
- There are serious scientific flaws:
  - Inconclusive results or incorrect interpretation
  - Fraudulent research
- It is poorly written
- It does not address a big enough problem or advance the scientific field
- Most of the work was previously published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

Structure

Paper Structure

Elements of a manuscript

- Title
- Abstract
- Keywords
- Introduction
- Methodology
- Results/Discussions/Findings
- Conclusion
- References

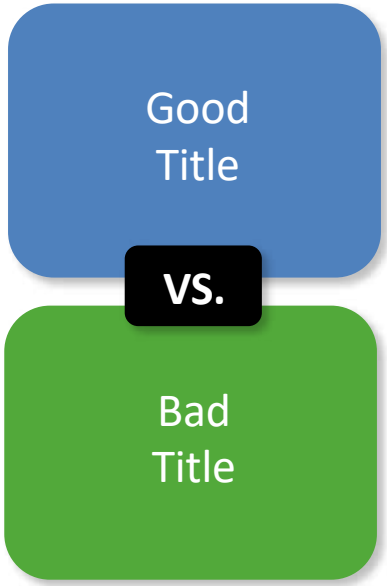


Paper Structure

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



Title Dos and Don'ts

✓ *A Human Expert-based Approach to Electrical Peak Demand Management*

VS

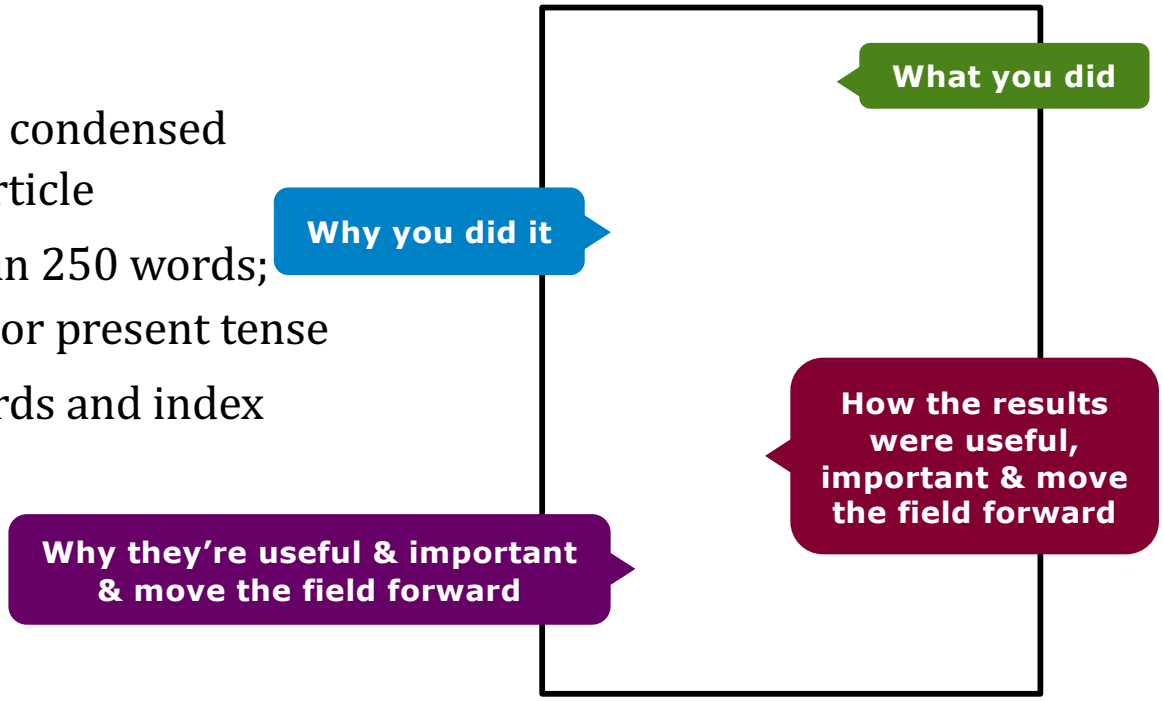
✗ *A better approach of managing environmental and energy sustainability via a study of different methods of electric load forecasting*

Paper Structure

Abstract

A "stand alone" condensed version of the article

- No more than 250 words; can use past or present tense
- Uses keywords and index terms



Paper Structure

Abstract Dos and Don'ts

✓

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

✗

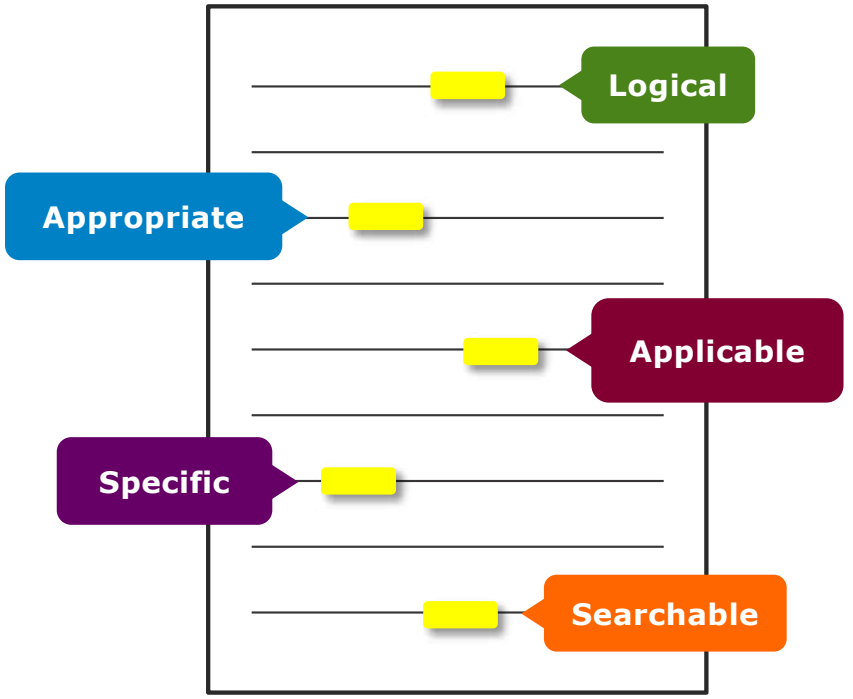
This paper presents and assesses a framework for an engineering capstone design program. **We explain** how student preparation, project selection, and instructor mentorship are the three key elements that must be addressed before the capstone experience is ready for the students. **Next, we describe** 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

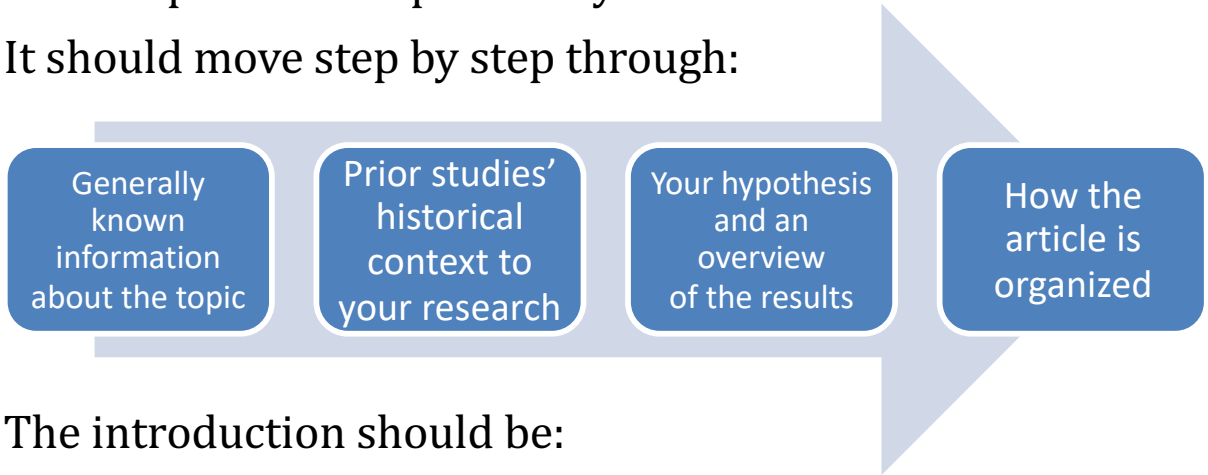
Use in the Title and Abstract for enhanced Search Engine Optimization



Paper Structure

Introduction

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



- The introduction should be:
  - Specific, not too broad or vague
  - About 1-2 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 and support conclusions:

Tables
Present representative data or when exact values are important to show

Figures
Quickly show ideas/conclusions that would require detailed explanations

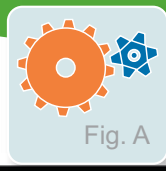


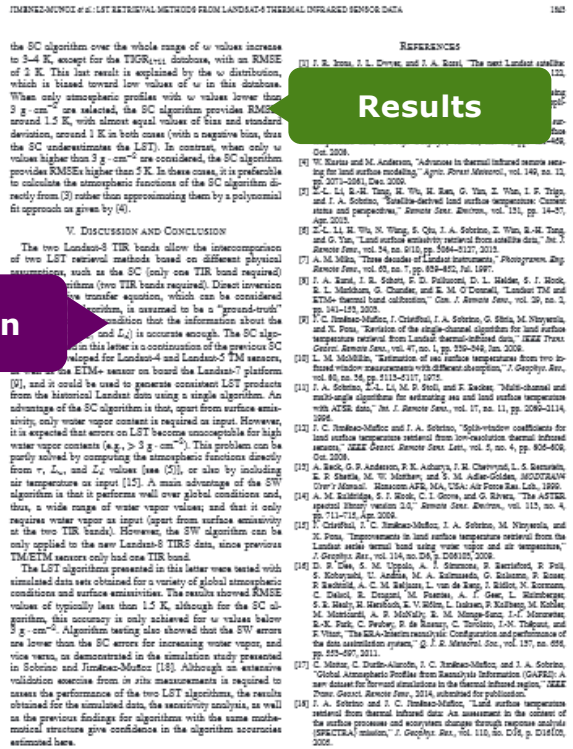
Fig. A

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

Discussion

Results: Summarizes the 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
- How can it benefit other researchers professionals

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 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 your work (about 30)
- Ensure proper author attribution
  - Author name, *article title*, publication name, publisher, year published, volume and page number, Digital Object Identifier (DOI)

1574 IEEE TRANSACTIONS ON SMART GRID, VOL. 5, NO. 4, JULY 2014

We then have

$$(P_t^{h+}+P_t^{g-})^2-(P_t^{g+}-P_t^{h-})^2+4P_t^{h+}P_t^{g-}$$
$$<(\hat{P}_t^{g+}-\hat{P}_t^{h-})^2+4\hat{P}_t^{h+}\hat{P}_t^{g-}$$
$$-(\hat{P}_t^{g+}+\hat{P}_t^{h-})^2. \quad (32)$$

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

$$c_{o/m}(P_t^{g+},P_t^{g-})<c_{o/m}(\hat{P}_t^{g+},\hat{P}_t^{g-}). \quad (33)$$

Therefore the optimal pair $\{P_t^{g+},P_t^{g-}\}$ must satisfy that $P_t^{g+}P_t^{g-}=0$, i.e., only one of P_t^{g+},P_t^{g-} can be non-zero. ■

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Peng Yang (S'11) received the B.Sc. degree in electrical engineering from University of Science and Technology, Anhui, China in 2009, and the M.Sc. and Ph.D. degrees in electrical engineering from Washington University in St. Louis, St. Louis, MO, USA, in 2011 and 2014, respectively. His Ph.D. advisor is Dr. Arye Nehorai.

His research interests include statistical signal processing, optimization, machine learning, and compressive sensing, with applications to smart grids.

Arye Nehorai (S'80–M'83–SM'90–F'94) received the B.Sc. and M.Sc. degrees from the Technion, Haifa, Israel, and the Ph.D. degree from Stanford University, Stanford, CA, USA.

He is the Eugene and Martha Lohman Professor and Chair of the Preston M. Green Department of Electrical and Systems Engineering (ESE) at Washington University in St. Louis (WUSTL), St. Louis, MO, USA. Earlier, he was a faculty member at Yale University and the University of Illinois at Chicago.

Dr. Nehorai served as Editor-in-Chief of IEEE TRANSACTIONS ON SIGNAL PROCESSING from 2000 to 2002. From 2003 to 2005 he was the Vice President of the IEEE Signal Processing Society (SPS), the Chair of the Publications Board, and a member of the Executive Committee of this Society. He was the founding Editor of the special columns on Leadership Reflections in *IEEE Signal Processing Magazine* from 2003 to 2006. He has been a Fellow of the IEEE since 1994, the Royal Statistical Society since 1996, and the AAAS since 2012.

Properly cited material

Who should be on the Authors' list

A Report

A report documents in detail the work done including results for a project and has a lead author and other multiple authors

A Technical Paper

- It highlights one or more aspects of a report
- Multiple papers can come out of one report
- Include any and all who have contributed to the writing of the paper
- Others can be acknowledged

Ethics

Ethics

Types of misconduct

Conflict of Interest

- A financial or other relationship with the publication at odds with the unbiased presentation of data or analysis.

Plagiarism

- Copying another person's work word for word or paraphrasing without proper citation.

Missing Author Attribution

- Must be given if you use another author's ideas in your article, even if you do not directly quote a source.

Ethics

Ethical publishing

Plagiarism

- Avoid plagiarism
  - Cite and separate any verbatim copied material – but how much?
  - Paraphrase other's text properly, and include citation
  - Credit any ideas from other sources
  - Familiarize yourself with IEEE Policies

Refer to our Tips Sheet
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Ethics

Ethical publishing

Duplication, Redundancies & Multiple Submissions

- Author must submit original work that:
  - Has not appeared elsewhere for publication
  - Is not under review for another refereed publication
  - Cites previous work
  - Indicates how it differs from the previously published work
  - Authors MUST also **inform the editor** when submitting any previously published work

Refer to our Tips Sheet
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Most articles are traditional, some are open access (author preference)

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IEEE provides 3 open access publishing options to meet the varying needs of authors:

- New multidisciplinary journal, IEEE Access
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PES Full Open Access Option #1

IEEE Open Access Journal of Power and Energy

- Will start publishing articles from January 2020
- Existing OA Journal of Power and Energy Technology Systems will be rebranded with this new name, scope covering the entire field of PES for both practice-oriented and academic articles
- Article processing charge subsidised at US$1350
- Between 10-15 articles each year will receive further subsidy depending on authors' affordability/circumstances

PES Full Open Access Option #2

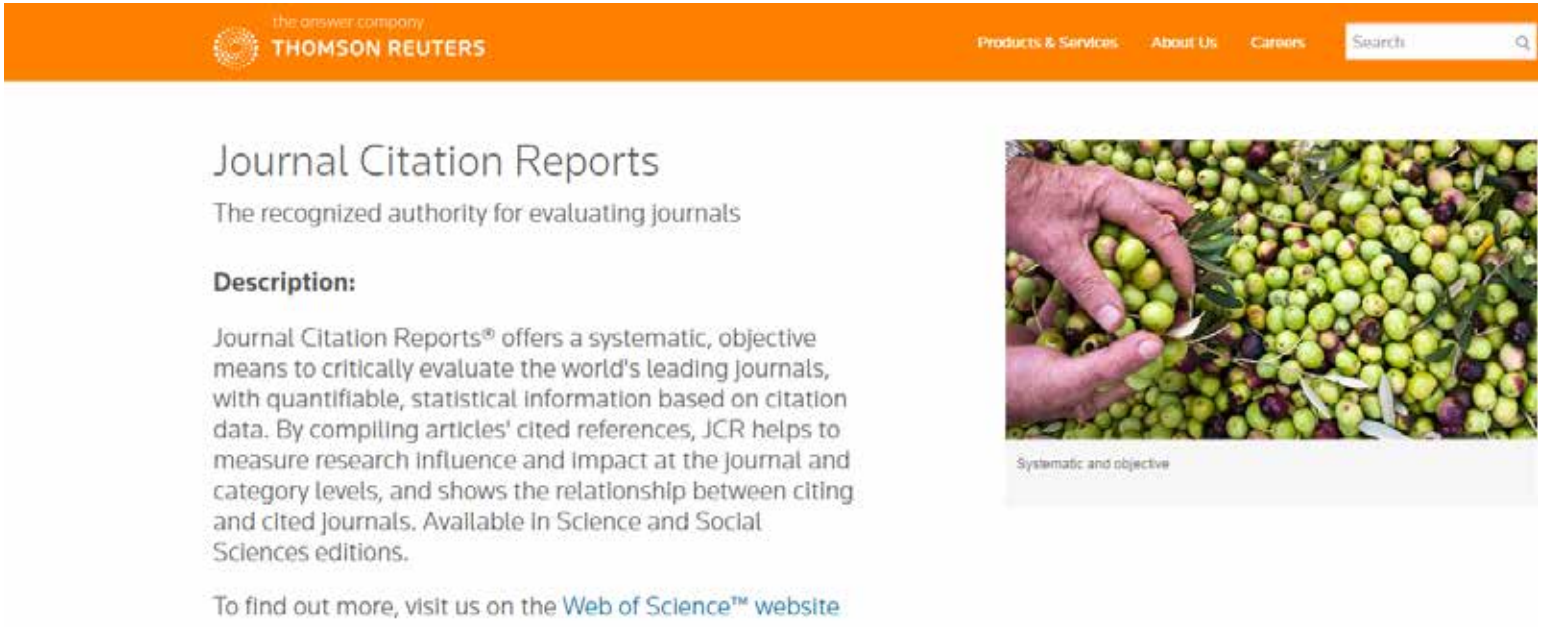
A dedicated section on Power & Energy for publishing papers in the PES field in IEEE Access

- The section will start from January 2020, submissions started in September 2019
- Paper will be handled by 3 PES-appointed Editors
- APC: US$1750

Impact Factor

Are we depending too heavily on Impact Factors?

Impact Factor from Journal Citation Reports



Impact Factor is not necessarily enough of a metric

Other attributes:

- Journal's reputation in the community is important
- For new and lesser known journals – look at the editorial board, their reputation

Other ways of judging a journal's value to the engineering community

1. **Number of Downloads** (IEEE uses this information for revenue distribution)

2. **Patent Citations** (Available from IEEE)

Follow-up Steps

Process of Writing the Paper

Discuss the content among team members
Literature search – Reference List
Description of the Experiment/Model
Results/Discussion
Write the Conclusion
Collect the components – Prepare the draft
All members comment on the draft
Produce the final copy

I would like to see a broader IEEE

We need to ensure that we are “READY FOR RECOVERY”, when we get back to the “NEW NORMAL” after COVID-19. Let us enhance cooperation, collaboration and community spirit.

For this we need to make IEEE broader so that IEEE is more relevant to the work our members do regardless where they work.

We need more participation from volunteers globally in IEEE governance. A broader based IEEE will make the Institute more relevant to technologists and academics from all parts of the world.

I would like to see more IEEE Senior Members and IEEE Fellows from Regions 8, 9 & 10

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IEEE Petitions Available for Signing

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