How to write a basic technical paper?

Eszter Lukács

e.lukacs@ieee.org

http://ieeexplore.ieee.org/
1884: Where we came from
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
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

1912: The Institute of Radio Engineers is founded

1922: Triode vacuum tube inventor Lee de Forest with a radio
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World’s largest technical membership association with more than 430,000 members in over 160 countries

Not for profit organization “Advancing Technology For Humanity”

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- Conferences organizer
- Standards developer
- Publisher of journals, conferences, standards, ebooks and elearning

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More than 75 new journals added in the last ten years
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Clarivate Analytics Journal Citation Reports® by Impact Factor

### IEEE publishes:

<table>
<thead>
<tr>
<th>Category</th>
<th>Journals</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 of the top 25 journals in Electrical and Electronic Engineering</td>
<td></td>
</tr>
<tr>
<td>14 of the top 15 journals in Telecommunications</td>
<td></td>
</tr>
<tr>
<td>4 of the top 5 journals in Artificial Intelligence</td>
<td></td>
</tr>
<tr>
<td>3 of the top 5 journals in Computer Science, Hardware &amp; Architecture</td>
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<tr>
<td>3 of the top 5 journals in Automation &amp; Control Systems</td>
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<tr>
<td>2 of the top 5 journals in Computer Science, Cybernetics</td>
<td></td>
</tr>
<tr>
<td>2 of the top 5 journals in Imaging Science &amp; Photographic Technology</td>
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</tbody>
</table>

The Clarivate Analytics Journal Citation Reports presents quantifiable statistical data that provides a systematic, objective way to evaluate the world’s leading journals.

Based on the 2016 study released June 2017

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- IEEE
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- American Institute of Physics (AIP/AVS)
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- John Wiley and Sons/Wiley-Verlag/Wiley-Liss
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IEEE is cited over 3x more often than any other publisher

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<thead>
<tr>
<th>Broadcasting</th>
<th>Computer hardware</th>
<th>Computer software</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information storage</td>
<td>Measuring, testing, and control</td>
<td>Medical devices</td>
</tr>
<tr>
<td>Nuclear and X-ray</td>
<td>Optics</td>
<td>Power systems</td>
</tr>
<tr>
<td>Robotics</td>
<td>Semiconductors</td>
<td>Smart Grid</td>
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<tr>
<td>Solar/Photovoltaic</td>
<td>Telecommunications</td>
<td>Wind Energy</td>
</tr>
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</table>

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Content on IEEE Xplore Digital Library
Full text content from all 39 IEEE Societies

IEEE Aerospace and Electronic Systems Society
IEEE Antennas and Propagation Society
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<table>
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<th>PRO</th>
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<tr>
<td><strong>IEEE Journals</strong></td>
<td><strong>IEEE Conferences</strong></td>
</tr>
<tr>
<td>• IEEE journals are cited 3 times more often in patent applications than other leading publisher’s journals</td>
<td>• IEEE Conference proceedings are recognized worldwide as the most vital collection of consolidated published articles in EE, computer science, related fields</td>
</tr>
<tr>
<td>• A high percentage of articles submitted to any professional publication are rejected</td>
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<th>Title</th>
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<th>Impact Factor</th>
<th>Submission to Publication Time in Xplore</th>
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<tr>
<td>Intelligent Vehicles, IEEE Transactions on</td>
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The theory, design and application of Control Systems. It shall encompass components, and the integration of these components, as are necessary for the construction of such systems. The word ‘systems’ as used herein shall be interpreted to include physical, biological, organizational and other entities and combinations thereof, which can be represented through a mathematical symbolism. The Field of Interest: shall include scientific, technical, industrial or other activities that contribute to this field, or utilize the techniques or products of this field, subject, as the art develops, to additions, subtractions, or other modifications directed or approved by the IEEE Technical Activities Board.

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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

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

Abstract

A “stand alone” condensed version of the article
- No more than 250 words;
  - Written in the past tense
- Uses keywords and index terms
The abstract must be a concise yet comprehensive reflection of what is in your article. In particular, the abstract must be as follows.

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2) Between 150-250 words. Be sure that you adhere to these limits; otherwise, you will need to edit your abstract accordingly.
3) Written as one paragraph, and should not contain displayed mathematical equations or tabular material.
4) Should include three or four different keywords or phrases, as this will help readers to find it. It is important to avoid over-repetition of such phrases as this can result in a page being rejected by search engines.
5) Ensure that your abstract reads well and is grammatically correct.
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.

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.
Paper Structure

Keywords

Use in the Title and Abstract for enhanced Search Engine Optimization

- Logical
- Appropriate
- Applicable
- Specific
- Searchable
<table>
<thead>
<tr>
<th>IEEE Keywords</th>
<th>Authors Keywords</th>
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<tbody>
<tr>
<td>Bit rate, Decoding, Encoding, Parallel processing, Video coding</td>
<td>High Efficiency Video Coding (HEVC), parallel programming, video coding</td>
</tr>
</tbody>
</table>

**INSPEC: Controlled Indexing**

- parallel processing, video coding

**INSPEC: Non-Controlled Indexing**

- 12-core system, H.264-advanced video coding, HEVC parallelization approaches, OWF, WPP, frequency 3.33 GHz, high efficiency video coding, overlapped wavefront, parallel efficiency, parallel friendliness, parallel scalability, parallelization proposals, tiles, wavefront parallel processing
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https://www.computer.org/web/peer-review/journals#Length of Review Process
Paper Structure

Introduction

- A description of the problem you researched
- It should move step by step through, should be written in present tense:
  - 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 **not be**
  - Too broad or vague
  - More than 2 pages
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
Fig. 1. Distributed generation system emulator set with control equipment in the laboratory.

Fig. 2. National Smart Grid Laboratory & Demonstration Platform diagram.

Fig. 3. Map showing locations of smart grid facilities across Norway.

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The Test Case Prioritization Problem.

Given: $T$, a test suite; $PT$, the set of permutations of $T$; $f$, a function from $PT$ to the real numbers.

Problem: Find $T' \in PT$ such that

$$(\forall T'' \in PT) \left( \left( T'' \right)'^{f(T')}, \left( T'' \right)'^{f(T''')} \right) > \left( T'' \right)'^{f(T'')}$$

Here, $PT$ represents the set of all possible permutations of a test suite, and $f$ is a function that, applied to any such ordering, yields an associated numerical value.
The Test Case Prioritization Problem.

Given: $T$, a test suite; $PT$, the set of permutations of $T$; $f$, a function from $PT$ to the real numbers.

Problem: Find $T' \in PT$ such that

$$\left( \forall T'' \in PT \right) \left( T'' \neq T' \right) \left[ f(T') \geq (T'') \right].$$

Here, $PT$ represents the set of all possible prioritizations (orderings) of $T$ and $f$ is a function that, applied to any such ordering, yields an award value for that ordering.
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
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
Support and validate the hypothesis your research proves, disproves or resolves.

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Writers last task once all sections are written:

• How do they fit together?
• Does each section perform its appointed task?
• Is the order logical?
• Do the ideas flow together? Is it easy to read?
• Does the same material appear more than ones?
• Can it be clearer?
• Is there enough detail?
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Review

Review Process

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Audience

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- **Enhance Your Article: Share Your Code via Code Ocean** on **28 June 2017**, 10:00-11:00 a.m. EDT. This one-hour online training provides IEEE authors with an overview of the partnership IEEE has in place with Code Ocean—a cloud-based executable research platform that allows authors to upload, share and run their code. This partnership allows readers of IEEE Xplore articles that contain associated code linked to the article the ability to execute the code in the cloud without any special hardware or setup. Spend an hour with us to learn more about how you can enhance your article. Presented by Simon Adar, Code Ocean.

- **Publishing Your Article in a Journal** on **18 July 2017**, 1:00-2:00 p.m. EDT. This one-hour course covers why publishing is important, the
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