Technical Writing

Senior Design Project Course 1 (25780)

Department of Electrical Engineering
Sharif University of Technology

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Effective Technical Writing

Outline

- **Why Write?**
- Technical Paper Format
- Conference Tips
- General Writing Tips
- Examples and Exercises

Why Write?

- New Insights.
- Expert feedback on the reported work.
- Professional interest in sharing results.
- Management awareness.
- Renewed research funding.
- Prestige/recognition.

Types of Writing

- Types of Writing
  - Fiction / non-fiction.
  - Poetry / Prose.
  - Novels, short-stories, plays, screen plays, …
  - University Writings:
    - Letters and essays,
    - Literary analysis papers,
    - Proposals and dissertations,
    - Critical reviews,
    - Scientific Reports.

Purpose of Technical Writing

- **To inform (reports, instructions, descriptions)**
  - To provide the audience with factual information
  - Remain as concise as possible.
  - Explain ideas in enough detail to make it understandable to your audience.

Purpose of Technical Writing

- **To persuade (proposals, recommendations)**
  - To convince the audience to draw the desired conclusions from the provided information
  - Try to remain, or appear to remain, as objective as possible.
  - Appeal to logic, not emotion.
  - Provide evidence for all arguments
  - Answer the question “Why?”: “Why is this important?”, “Why is this beneficial?”, “Why is this a problem?”

Audience

- Just as you have a purpose in writing, your audience has a purpose in reading.
- Your goal is to ensure that the ideas you have when writing are the same ideas that your audience has when reading.

This Class… Why and What (1)

- Our focus is on:
  - Technical writing – anything having to do with specialized areas of science and technology.
  - Formal conference papers but this class material also applies to application notes, product specifications, invention disclosures, emails, …

This Class… Why and What (2)

- **Effective Technical Writing**
  - **Inform, Preserve Knowledge**
    - Document what you know, discovered, invented, …
  - **Communicate your knowledge and ideas to others**
    - Your peers - inside and outside your company/university
    - Future employers?
  - **Professional Development**

Effective Technical Writing

- Outline
  - Why Write?
  - **Technical Paper Format**
  - Conference Tips
  - General Writing Tips
  - Examples and Exercises

Technical Paper Format (1)

- **Abstract**
- **Introduction**
- **Body**
- **Conclusion**
- **Acknowledgments**
- **References**

Technical Paper Format (2)

- **Abstract**
  - Summarize the paper.
  - Highlight the problem and the main results.
  - Typically no more than 100-150 words.
  - No references in an Abstract – must stand alone.
  - Include keywords immediately after the abstract.

    Required for some IEEE publications,
    - "Help identify and emphasize important subject matter they report." 1998 IEEE Approved Indexing Keyword List.
    - Assists with on-line researches.

Example Abstracts (1)

ESD Protection for High Voltage Semiconductor Devices

Matthew Tyler

Utah Technology and Design Center

Problem statement

Abstract

High voltage MOS transistors are inherently difficult to protect from ESD stress. The asymmetrical nature of the Vgs and Vds lead to early device failure when driven into breakdown. This paper presents fast triggering pad oriented SCR structures with a common ESD discharge bus as a solution to this design challenge.

Solution, Key idea

Example Abstracts (2)

Low-Jitter Active Deskewing Through Injection-Locked Resonant Clocking

Zheng Xu and K. L. Shepard
Columbia University, Department of Electrical Engineering

Problem statement

Abstract

Active deskewing is an important technique for managing variability in clock distributions but introduces latency and power-supply-noise sensitivity to the resulting networks.

In this paper, we demonstrate how active deskewing can be achieved with resonant distributions without introducing significant jitter. The prototype network operates at a nominal 2-GHz frequency in a 0.18u CMOS technology with more than 25pF/mm2 of clock loading.

Solution with results

Abstract Recap

- **Abstract**
  - Summarize the paper.
  - Highlight the problem and the main results.
  - Clear, concise – lets me know if I need/want to read the rest of the paper.

Technical Paper Format (3)

- **Introduction (5 sections)**
  - **Paragraph 1: Motivation – general**
    - What is the problem area you are working on, why is it important?
    - Why is the problem of interest and importance to the larger community?
  - **Paragraph 2: Describe the specific problem**
    - Specific context and background
  - **Paragraph 3: "In this paper we show…"**
    - Summarize the main contributions of your paper in context establish in paragraphs 1 and 2
    - What approach was taken, why are the results significant?

Technical Paper Format (3)

- **Introduction (continued)**
  - **Paragraph 4: The difference between your solution and others.**
    - What is new about your work?
  - **Paragraph 5: "The remainder of this paper is constructed as follows…".**
    - Roadmap of the rest of your paper, set expectations.

Technical Paper Format (4)

- **Body**
  - Generally two-four pages.
  - Define the problem being considered in detail.
  - Describe your solution and results.
    - Be clear what point you are trying to convey to the reader.
    - Explain your theory or the theory your work is based on.
    - Analyze complexity, overhead, cost of your approach.
    - Show results, examples that support your theory.
    - Compare actual results with predicted results or previous works.
    - Acknowledge limitations – no work is perfect.

Technical Paper Format (5)

- **Body (continued)**
  - Define all terminology and notation used
  - Introduce figures to demonstrate key ideas
    - A picture is worth a thousand words!

Technical Paper Format (6)

- **Conclusion or Summary**
  - Summarize what has been accomplished and emphasize the main result.
  - Main points in your paper should appear three times:
    - Abstract
    - Body
    - Conclusion
  - You can also address open issues or indicate future directions.

Technical Paper Format (7)

- **Acknowledgements**
  - Acknowledge individuals or organizations who contributed to the work described.
    - Research partners, sponsors, contributing colleagues that are not authors, etc.
- **References**
  - List works referred to in the paper.
  - Cited in numerical order according to their order of appearance.
  - List printed web references as well as printed media.

Effective Technical Writing

- Outline
  - Why Write?
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  - **Conference Tips**
  - General Writing Tips
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Conference Tips (1)

- **Your abstract and introduction are crucial,**
  - Some reviewers go no further if these are not clear.
- **Before telling what you did, tell me why I should care,**
  - Does your paper make clear PRECISELY what YOUR NEW contributions are, and how they are different/better than existing approaches?
  - Remember – each reviewer generally reads 15+ papers
    - Don’t make them work to figure out the value of your paper.

Conference Tips (2)

- **Present silicon results (if possible),**
  - May be the difference between a paper and poster or accepted / not accepted.
- **Do not use/over-use your company or product name,**
  - Technical reviewers hate “marketing” or “sales” papers.
  - Focus on the technical problem, your solution and results.

Conference Tips (3)

- **What are reviewers thinking when they read your papers?**
  - Will this advance the state of art?
  - Did I learn anything new?
  - Does it provide evidence that supports/contradicts hypotheses?
  - Experimental validation?
  - Will the paper generate discussion at the conference?
  - How readable is the paper?
  - Is the paper relevant to a broader community?

Conference Tips (4)

- **Ask for the conference scoring criteria!**
- **Example: Custom Integrated Circuits Conference (CICC)**
  - **Technical merit:** Dept of technical material presented. Are the results clear and complete? If a design, has the chip been fabricated and tested? Is the topical flow of the paper reasonable? Could you explain the key ideas to a peer from just reading the paper?

Conference Tips (4)

- **Significance:** How useful is the work in advancing the technology of the field in which it is presented? How likely is a significant change in the industry due to this material?
- **Note:** Reviewers should score each paper in each of the four categories described above on a scale of 1 to 5, 1 being the worst, 5 being the best. Hence, a paper outstanding in every way could have a total score of 20, while an absolutely terrible paper should have a total of 4.

Conference Tips (4)

- **Clarity:** How “readable” is the paper? Does the author communicate well? Is the grammar/ spelling/English usage adequate? Is the topical flow of the paper reasonable? Could you explain the key ideas to a peer from just reading the paper?
- **Originality:** To your knowledge, how original is the work compared to the work within that field? Does the author advance the state of art?

Conference Tips (5)

- Read and meet conference requirements!
  - Paper length, subject area, preferred template
  - Submission deadline!
  - First-published-work requirement.
    - Each submission should have some new, significant finding or data.

Conference Tips (6)

- **IEEE Publication Policy**
  - 6.4 Multiple Publication of Original Technical Material in IEEE Periodicals
    - IEEE's technical publications shall include original material which appears only once in the archival literature. Unusual circumstances may allow for exceptions to this policy*. The appropriate procedures to be followed shall be specified in the PSPB Operations Manual.

* Example: Invited or tutorial paper

Conference Tips (7)

- **Who is an author?**
  - IEEE policies (Section 6.4.1) states the following about the authorship:

    "The IEEE affirms authorship credit must be reserved for individuals who have met each of the following conditions:

    1) made a significant intellectual contribution to the theoretical development, system or experimental design, prototype development, and/or the analysis and interpretation of data associated with the work contained in the manuscript,

Conference Tips (7)

2) contributed to drafting the article or reviewing and/or revising it for intellectual content, and

3) approved the final version of the manuscript, including references.

Effective Technical Writing

- Outline
  - Why Write?
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  - Conference Tips
  - **General Writing Tips**
  - Examples and Exercises

General Writing Tips (1)

- **Write from an outline.**
  - Top-down strategy.
    - Present the big picture first, then work toward the details.
  - Identify major sections of your paper.
    - Write down the main points you want to make in each.
    - Use bullets – don't spend time on full sentences at this stage.

General Writing Tips (1)

- Ensure your ideas are in correct order.
  - Can the reader understand each passage strictly from the material presented to this point?
- One main point per paragraph.
- Option: write the abstract and conclusion after the main paper is complete.

General Writing Tips (2)

- **Be clear and concise.**
  - Do not over-formalize your writing.
    - You do not sound smarter.
    - “Overblown” writing makes your paper harder to read and understand.
  - Avoid buzz-words and buzz-phrases.
    - Word-class, leading-edge, novel, high-performance.

General Writing Tips (2)

- Omit needless words – when you can cut, cut.
  - Don't be surprised if this turns out to be 30-40% of your original text
    - Make assumptions → assume
    - Is an illustration of → illustrate
    - Is a requirement for → requires
    - Utilizes → uses
    - Functionality → function
    - Realized in → built in

General Writing Tips (3)

- **Reduce the "Fog Index".**
  - Fog Index F = 0.4 (L+P).
    - L is the average number of words per sentence.
    - P is the average number of polysyllables (three or more syllables) per 100 words of text.
  - Strive for F<10.
  - Fog index > 15 is a warning that your text will be difficult to read.

General Writing Tips (4)

- **Example 1: F=33**

  “In order to eliminate the possibility of errors occurring in the time charges related to engineering jobs through transposition of numbers or typing errors, each of the division planning offices must set up a file of time cards showing all authorized project numbers and make a daily check of charges on all time sheets forwarded to the Accounting Department to be sure that only authorized numbers are used.”

  (One sentence, 69 words, 12 polysyllables)

General Writing Tips (5)

- **Example 2: F=8.4**

  "It is easy to transpose digits and make typing errors when entering project numbers. We suggest each Division Planning Office set up a file of time cards showing all authorized project numbers. Then all charges should be checked each day before sending time sheets to the Accounting Department."

  (3 sentences, 48 words, 5 pollysyllables)

General Writing Tips (6)

- **Verbs**
  - Passive
    - "The data was measured and the results were correlated."
  - Active
    - "We measured the data and correlated the results."
  - The reader needs to know who is doing what
    - Passive verbs often obscure both the agent and the recipient of the action.

General Writing Tips (7)

- **Check for consistent use of verb tense**
  - Use the past tense for things that happened in the past
    - E.g., the experiments you performed, results you collected.
  - Use the present tense for things that are true now and will continue to be true in the future,
    - E.g., “The processor runs at 250MHz.”

General Writing Tips (8)

- Do not use “this” as a pronoun.
  - Avoid sentences such as “This is…” and “This gives…”
  - When “this” is used as a pronoun, its antecedent is often missing or poorly defined.
- Example: “By increasing the impedance, the radiation level is increased and the electrical field becomes stronger. This means that…”
  - What does “this” refer to?
  - Who did the increasing?

General Writing Tips (9)

- Use transition words
  - Use transitions words to combine thoughts between sentences.
  - These words make the flow smoother and the transition less abrupt:

Nevertheless	**Therefore**
Likewise	**Although**
Alternatively	**Additionally**
Conversely	**Furthermore**
Consequently	**However**

General Writing Tips (9)

- Delete meaningless words.
  - Avoid words that do not add any meaning to a sentence:
    - Basically, Generally, Kind of, Actually, ….

General Writing Tips (10)

- **Paragraphs**
  - Break up your writing into paragraphs.
  - Purpose is to help organize information into blocks.
    - Helps writer and reader.
  - Each block (paragraph) should develop “one idea”.
  - A good paragraph should be unified.
    - Clear focus, no off-topic material.
  - A good paragraph should also be coherent.
    - The sentences in the same paragraph should connect to each other.

General Writing Tips (11)

- **When to Start a New Paragraph?**
  - To introduce a new idea.
  - To give the reader a chance to regroup.
  - To emphasize a point.
  - To break complicated information down into smaller pieces.
  - To sum up the main idea.

General Writing Tips (11)

- **What constitutes a "single idea"?**
  - Can vary, depending on the level of detail in your writing.
  - You might or might not have an explicit topic sentence, but you definitely should have a topic in mind for each paragraph.
- **How Long Should a Paragraph Be?**
  - No strict rule. More important for the paragraph to do a good job at conveying its point.
  - But generally, avoid one-sentence paragraphs and multi-page paragraphs.

General Writing Tips (12)

- **Run spell-check on your paper and make all corrections!**
  - There is no excuse for incorrect spelling in a professional paper.
  - Spelling errors convey that you don't care about your paper so why should your reviewer?

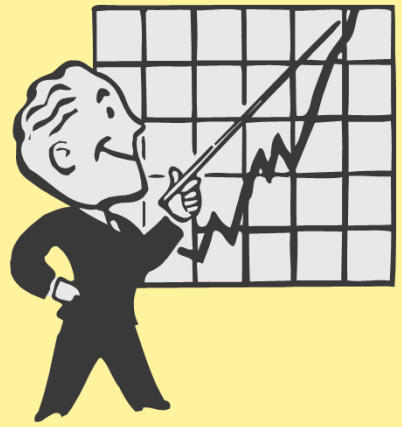
General Writing Tips (12)

- **When using spell-check, double-check the suggested replacement spelling!**
  - Tapeout → take-out, teapot
  - Comma → coma
  - Simulation → stimulation
  - Vias → visa
  - Chip → chimp

General Writing Tips (13)

- **If you are not writing in your native language, have a native speaker read your paper.**
  - Check for missing articles if your native language does not use them (the, a, an).
- **If you are writing in your native language, avoid idioms, slang, colloquial phrases.**

General Writing Tips (14)



- **Figures and Tables**
  - Complement your text with figures.
    - Figures can summarize, clarify, verify your text.
  - Check that your text and figures/tables agree!
  - Ensure information is clear in color AND black and white.
  - Don’t use fonts below 8 for legends, axis, etc.
  - Captions should describe the content of the figure/table.

General Writing Tips (15)

- Read other papers to see how to write (and not write) effectively.
  - Look for “Best Papers” and “Invited Papers”.
- Don’t wait until the last minute.
- Ask several peers to review your paper.
  - An expert in your subject matter.
  - One who is not an expert.
- Give credit where credit is due
  - Research related work and acknowledge it.

General Writing Tips (16)

- **Complete Comparisons.**
  - More, faster, slower, lower … Than What???
- **Use modifiers once.**
  - More and more, faster and faster, …
  - Appropriate for an adventure novel – not technical writing!
- **Use too few rather than too many equations.**

General Writing Tips (17)

- **Correct use of “that” versus “which”.**
  - “Which” is used to introduce a *non-restrictive* clause.

    Use which, which is always proceeded by a comma, when introducing non-essential information.

General Writing Tips (17)

Example: Resistors, which have pretty color bands, are common elements in electronic circuits.

- "That" is used to introduce a *restrictive* clause.

  Use that, never proceeded by a comma, when introducing essential information.

Example: A resistor that has smoke rising from it is in danger of failing.

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  - **Examples and Exercises**

Examples (1)

- A fault recovering flip-flop which can enable dynamic clock adjustment of clock timing when an error is detected during normal operation is proposed in the third paper, and measurement results are presented to demonstrate its efficacy. This technique can enable robust design operation for SOC-level integration Ics realized in 65 nm-or-below process nodes with environmental-, integration-, or process-related timing and noise margin impairments. (F=21!)

Examples (1)

- The third paper describes a fault-recovering flip-flop that enables dynamic clock timing adjustment on error detection. This technique enables robust design operation or SOC ICs with environmental, integration, or process-related timing and noise problems at 65nm or below. Measurement results are included. (F=10.4)
- Comments:
  - What? Shorter sentences, fewer fancy words to reduce the Fog Index. Remove “which”, “realized” and “efficacy”.

Examples (2)

- The design of flow significantly depends on data and information provided by Silicon vendor for those IP/Library and design guidelines so that it is critical factor to integrate entire development effort across the team. (F=16)

Examples (2)

- The design contains a significant number of libraries and IP elements from an external vendor. Therefore the entire design team must understand the vendor's design guidelines to effectively integrate the IP. (F=9)
- Comments:
  - What? I had to read the first sentence three times and still had to "guess" what it said. Serious Fog.
  - Main point is lost because the author was trying to jam too much in a single sentence.
  - Missing articles, why is Silicon capitalized?

Exercises (1)

- Before:
  - The techniques to design logic circuits have been extensively studied in the past.
- After:
  - Logic circuit design techniques have been studied extensively.

Exercises (2)

- Before:
  - We will discuss each command and all those options we will be using in details.
- After:
  - We will discuss each command and the options used in detail.

Exercises (3)

- Before:
  - RTL code: the generation of RTL code is a complex task that targets expressing in Verilog and/or VHDL the intended behavior of the design.
- After:
  - RTL code generation is a complex task that involves describing intended behavior in Verilog and VHDL.

Comments: When you can cut, cut!

Remove “of” and “of the”.

Exercises (4)

- Before:
  - There are many Design-For-Test (DFT) rules needed to be observed in order to achieve good test coverage and meet out test coverage goals. If these rules are observed and followed, then Tetra Max or Fast Scan can general test vectors to achieve our test coverage goals.
- After:
  - The following design-for-test (DFT) rules must be observed to achieve AMI's test coverage requirements and enable test vector generation with Tetra Max or Fast Scan.

Exercises (5)

- Before:
  - There should only one scan clock for the whole chip even its has multiple clock domains.
- After:
  - Only one scan clock per chip is allowed regardless of the number of clock domains.

References

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