Writing a Technical Report

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Introduction

- Purpose of a technical report
  - A document that communicates technical information and findings
  - Presents analysis, research, or experimental results
  - Provides recommendations or solutions

Technical writing

- Journal paper
- Thesis
- Dissertation
- Report

Key Elements of a Technical Report

- Title page
- Abstract/Executive summary
- Table of contents
- Introduction
  - Literature Review
- Methodology
  - Theory and Analysis
  - Experimental Procedures
- Results and Discussion
- Conclusion(s)
- Acknowledgments
- References
- Appendices

Writing Mechanics

- Check Spelling
- Check Grammar
- Minimize the use of Acronyms
- If Acronyms are necessary, always define them at the first use
- Number all equations, tables, and figures
- All tables and figures must have captions.
- All figures must have labeled axes
- All quantities must have units
- Try to avoid footnotes

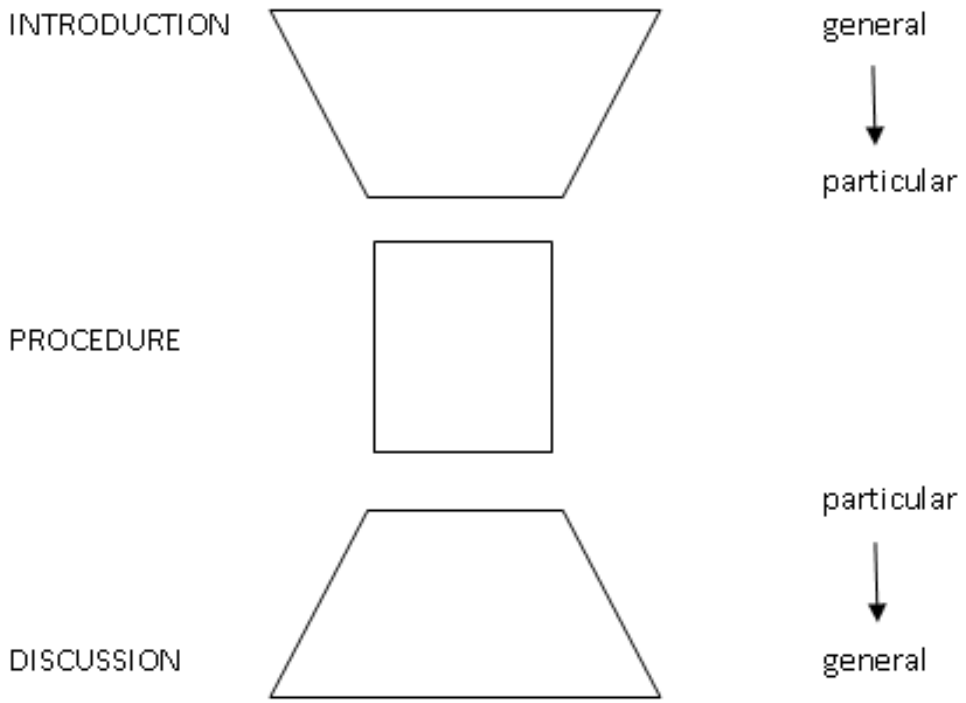
Writing Style

- Depends on the audience
- More Lively Writing (usually preferred)
  - First Person, Active Voice, Past/Present Tense
- More Formal Writing
  - Third Person, Passive Voice, Past/Present Tense
- Never use slang

Writing Style

- Use First-Person, Active Voice, Past Tense or Third-Person, Passive Voice, Past Tense
  - Not Recommended: *Clean the gallium arsenide substrates by boiling them in trichloroethylene.*
  - Not Recommended: *I clean the gallium arsenide substrates by boiling them in trichloroethylene.*
  - Acceptable: *The gallium arsenide substrates were cleaned by boiling in trichloroethylene.*
  - Recommended: *We cleaned the gallium arsenide substrates by boiling them in trichloroethylene.*

Organization



Overall organization of the research paper (Hill et al., 1982)

Writing the Report: An Approach

- Results come first
  - Your results are the heart of your paper
  - Begin by analyzing and understanding your data
  - The results section includes:
    - Figures/diagrams/plots (labeled, captioned and titled)
    - Data you didn’t expect
    - Your description of your figures
    - No conclusions

Writing the Report: An Approach

- Results section:
  - Use tables and graphs
  - Consider moving large quantities of raw data, detailed derivations, or code to an appendix
  - Methods of plotting which produce well delineated lines should be considered
  - Results should be critically compared to theory
  - Consider limitations in the theory and engineering tolerances

Writing the Report: An Approach

- What happens in the discussion?
  - The Discussion ties back to the Introduction
  - Talk about how and why you did or didn't confirm your **hypothesis**
  - Unexpected results
  - Speculate here!
  - Claims are grounded in **results** and background material in Introduction

Writing the Report: An Approach

- Now you are ready for the introduction
  - Brief background, enough to understand your **hypothesis**
  - State your hypothesis and your conclusion
  - “Introduction” is not a substitute for the report, and so does not echo the abstract
  - Here is the place for context, relation to prior work, general objective, and approach

- Next: title, abstract, conclusions and other sections

Title Page

- Report title
  - Title gives understandable label for the area of inquiry
- Author's name
- Date
- Organization/institution

Abstract/Executive Summary

- Abstract is a mini-paper (often around 200 words)
- Think of it as a substitute for the report for a busy reader: what if your reader has only access to the abstract?
- Purpose, Findings, Impact
  - Sentence One: expand on the title
  - Sentence Two: why the work was done
  - Remainder: key results, with numbers as appropriate, conclusions, recommendations

Introduction

- Background information on the topic
- Objectives and scope of the report

Sentences that serve the key purposes of an introduction

Example: Savage, S. Eraser: A Dynamic Data Race Detector for Multithreaded Programs. ACM Transactions on Computer Systems, 15 (4) 391-411

Describe your field:

Multithreading has become a common programming technique.

Explain why your problem matters

Unfortunately, debugging a multithreaded program can be difficult.

Summarize prior research:

The difficulties with using threads are well summarized by John Ousterhout.

Propose your solution:

In this article we describe a tool, called Eraser, that dynamically detects data races in multithreaded programs

Conclusion

- Similar to the abstract or executive summary
- Must be concise
- Reinforces key ideas formed in the discussion
- Includes recommendations for future work, such as implementation of a design
- Do not introduce new information

Methodology

- Detailed description of the methods used to conduct the research or analysis
- Include data collection, experimental setup, tools used, etc.

Theory and Analysis

- Briefly describe the theory relevant to the work
- Provide design equations
- Include calculations and computer simulation results
- Provide values for all key parameters
- State all assumptions

Experimental Procedures

- Describe Apparatus and Materials
  - Diagram of apparatus goes here (add a photo)
  - Open with an overview of the experimental design
- Show test setups
- This section should allow any electrical or computer engineer to duplicate your results:
  - Repeat experiment
  - Validate experimental design

Figures and Tables

- Every figure must have a caption
- All tables must have a title
- Figure/tables are placed after they are mentioned in the text
  - All must be mentioned/discussed
  - Summarize their data in the text
- Make figures/tables first, and then insert into the text
- Put the figure/table number beside its title, and put this in a standard location
- Don’t start a sentence with an abbreviation: Figure vs. Fig.

Example of Figures

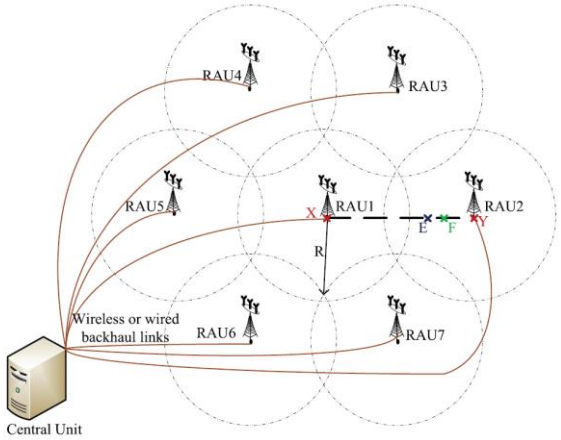


Fig. 1. Distributed MIMO system model.

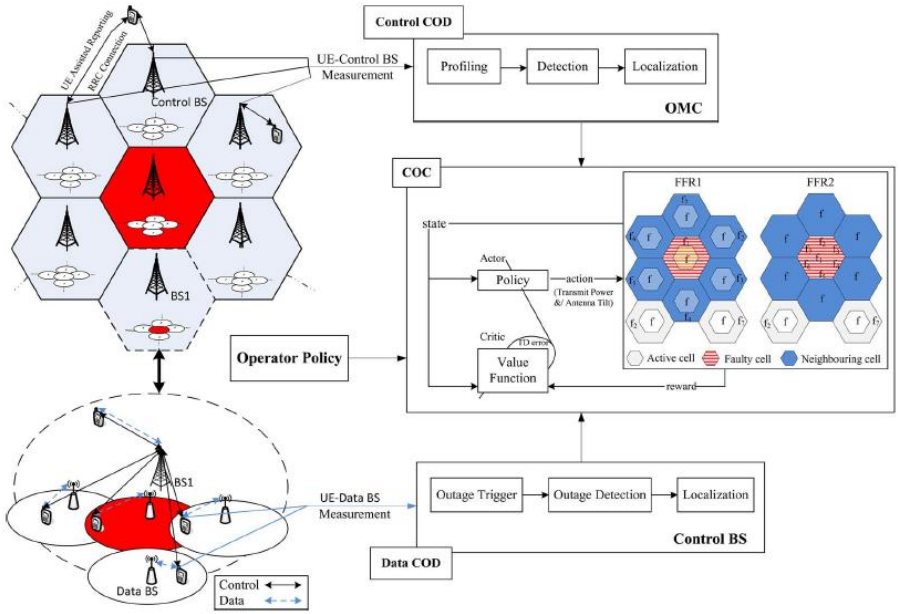


Fig. 1. Overview of the COM framework.

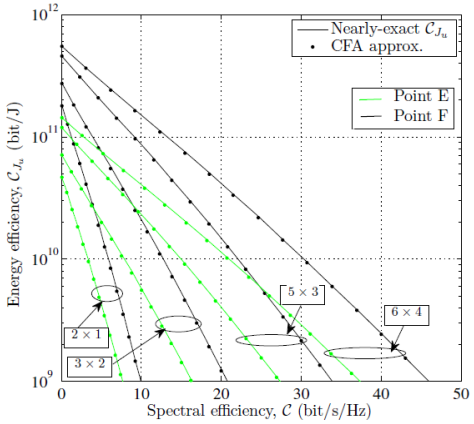


Fig. 5. Comparison of the EE-SE trade-off for the uplink of a 2-RAUs DMIMO system obtained via the nearly-exact approach and by our CFA when the UT is at position E and F, based on the idealistic PCM.

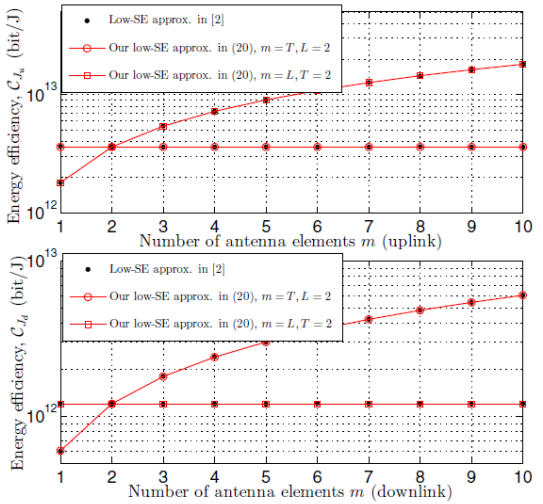


Fig. 7. Comparison of our low-SE approximation of the EE CFA for the uplink and downlink of DMIMO with the approximation in [2] when the UT is at position E, based on the idealistic PCM.

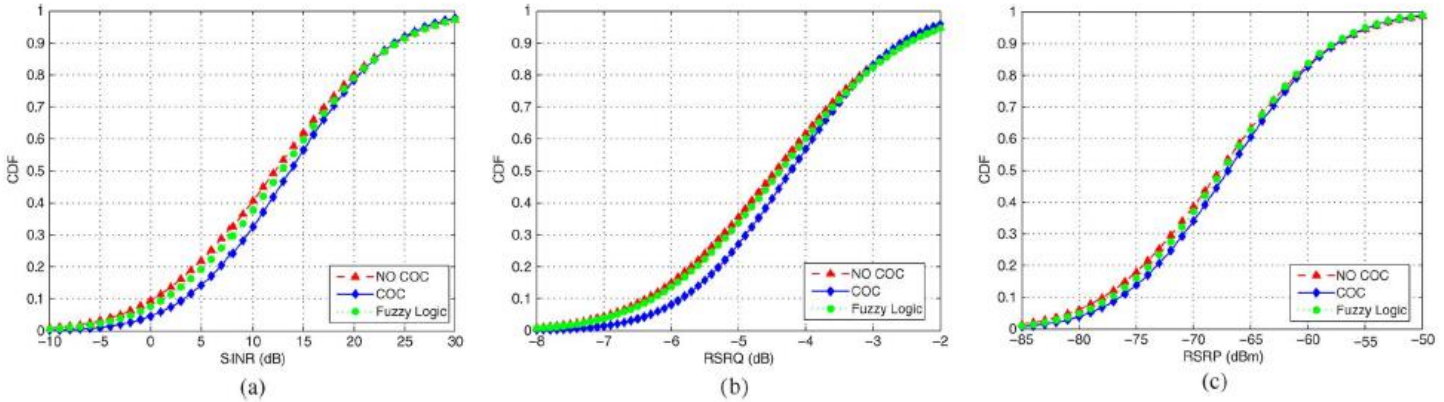


Fig. 11. Comparison of the cdf of the SINR, RSRQ, and RSRP of the COC with fuzzy logic and NO COC. (a) CDF of the SINR of the serving cells. (b) CDF of the RSRQ of the serving cells. (c) CDF of the RSRP of the serving cells.

Examples of Table

TABLE I
MDT REPORTED MEASUREMENTS

Measurement	Description
Location	Longitude and latitude information
Serving cell information	E-UTRAN cell global identification (ECGI)
RSRP	Reference signal received power (RSRP) in dBm
RSRQ	Reference signal received quality (RSRQ) in dB
Neighboring cell information	Three strongest intra-LTE RSRP, RSRP information

TABLE II
PARAMETERS FOR THE SYSTEM AND POWER MODELS

Realistic PCM [8]–[10]		**System Parameters**	
Parameter	Value	Parameter	Value
P_{0_u}	24.8 W	B	10 MHz
P_{0_d}	59.2 W	N_0	-169 dBm/Hz
Γ_{BS}	2.8	L_0	34.5 dB
P_{cr}	0.1 W	η	3.5
P_{ct}	0.1 W	D_0	1 m
Γ_{UT}	100 %	$P_{\max}$ (Uplink)	27 dBm
ϕ	0.5	$P_{\max}$ (downlink)	46 dBm
$\max_{dl}$	24	Fading	Rayleigh flat fading
p_{dl}	1 W		
c	1 W		
p_b	300W		
$Ag_{\max}$	24 Gb/s		

TABLE II
SIMULATION PARAMETERS

Parameter	**Value**
Tx Power Control BS	46 dBm
Tx Power Data BS	23 dBm
Path loss model	Friis spectrum propagation
Mobility model	pedestrian, speed 3 kmph, 60 kmph
UE distribution	Uniform random distribution
Scheduler	FFR
Shadow Fading	Log-normal, std = 2-10dB
AMC model	4-QAM, 16-QAM, 64 QAM
Macro cell layout	radius:500 m
Bandwidth per plane	5 MHz
No. of RBs	25; RBs per RBG:2
Antenna gain (Normal Scenario)	18 dBi
Antenna gain (Outage Scenario)	-50 dBi
MDT reporting interval	240 ms
Minimal sensible signal strength	-107.5 dBm
Detection threshold μ	0.5
Detection window size N	10
Grey weighting factor α	0.5
SINR threshold	-6 dB
Actions (Control BS power)	$0-46$ dBm per RB: Granularity 0.5 dBm
Actions (Data BS power)	$0-23$ dBm per RB: Granularity 0.5 dBm
Actions (tilt)	$0^\circ - 15^\circ$: Granularity 0.5°
Parameters τ, β, γ	0.1, 0.5, 0.98
Simulation time	10 minutes

O. Onireti, F. Heliot and M. A. Imran, "On the Energy Efficiency-Spectral Efficiency Trade-Off of Distributed MIMO Systems," in IEEE Transactions on Communications, vol. 61, no. 9, pp. 3741-3753, September 2013, doi: 10.1109/TCOMM.2013.071813.120823.

O. Onireti et al., "A Cell Outage Management Framework for Dense Heterogeneous Networks," in IEEE Transactions on Vehicular Technology, vol. 65, no. 4, pp. 2097-2113, April 2016, doi: 10.1109/TVT.2015.2431371.

Acknowledgements

- Keep track of those to be acknowledged-keep a diary so that you don’t forget anyone
- Include: your sponsor, outside sources (companies or agencies), other departments on campus, individuals outside of your team who have helped
- Be brief

“The research leading to these results has received funding from the EC’s 7th Framework Programme FP7/2007-2013 under grant agreement n∘247733-project EARTH.”

References

- List of sources cited in the report
- Various formats have been developed. Pick one you like such as the IEEE Transactions format
- Decide on a sequence, such as the order they appear in the text
- Always give full references such that others may find the item

References (format)

Book

[1] J. K. Author, “Title of chapter in the book,” in Title of His Published Book, xth ed. City of Publisher, (only U.S. State), Country: Abbrev. of Publisher, year, ch. x, sec. x, pp. xxx–xxx.

Conference Paper

[2] J. K. Author, “Title of paper,” presented at the Abbreviated Name of Conf., City of Conf., Abbrev. State, Country, Month and day(s), year, Paper number.

Journals

[3] J. K. Author, “Name of paper,” Abbrev. Title of Periodical, vol. x, no. x, pp. xxx-xxx, Abbrev. Month, year.

https://ieeeauthorcenter.ieee.org/wp-content/uploads/IEEE-Reference-Guide.pdf

Appendices

- Additional supporting/supplementary materials
- Include data, charts, proofs, diagrams, etc.

Plagiarism

- Never take the work of others without giving proper credit
- Never take verbatim sentences/paragraphs from the literature
- If you feel that you must use verbatim material, use quotation marks and a reference. Do this sparingly!
- There are search engines that can find if verbatim material has been stolen. Professors fail students who do this. Additional disciplinary action may follow.

Language and Style

- Use clear and concise language
- Avoid jargon, but include necessary technical terms
- Maintain a formal tone and objective perspective

Visual Elements

- Use tables, graphs, and visuals to support data and findings
- Ensure clarity and accuracy in presenting visual information

Formatting and Presentation

- Use a consistent and professional formatting style
- Pay attention to headings, subheadings, and numbering
- Proofread for grammar, spelling, and formatting errors
- Ensure proper spacing, font size, and margins

Tips for Effective Technical Writing

- Understand the report's purpose and target audience
- Plan and outline the report before writing
- Use a logical structure and clear headings
- Revise and edit for clarity, coherence, and accuracy

Reference

- William Strunk and E. B. White, The Elements of Style (New York: Macmillian, 2000).
- H. R. Fowler, The Little, Brown Handbook (Boston: Little, Brown and Company, 1980).
- G. L. Tuve and L. C. Domholdt, Engineering Experimentation (New York: McGraw-Hill Book Co., 1966).
- Craig Waddell, Basic Prose Style and Mechanics (Troy, NY: Rensselaer Press, 1990).
- Joseph Williams, Style: Ten Lessons in Clarity and Grace (Glenview, IL: Scott, Foresman, 1981).
- ECE Dept, "Technical Report Writing," 2011.