Approach towards Research and Publication

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Research

- the *systematic investigation* into and study of materials and sources (any subject) in order to *establish facts* and reach *new conclusions*.

Research types

- Basic research – driven by curiosity, general knowledge and understanding. Examples –Raman Effect, Theory of relativity etc

- Applied Research –driven by applications, practical needs. Example: computers, IoT etc

Steps involved

- Identification of area to match your skillset/ interests/ease
- Course work to build needed general background
- Literature Survey after choosing area (guide or you may decide jointly)
- Identification of problems to be investigated (dynamically changes) which should be present for 3 to four years from start till you submit thesis
- Define Goals –metrics (better performance-efficiency, speed, area, power, novelty, cost, trade-offs)
- On paper, explore new solutions (creativity needed)
- Simulate only after you are satisfied on paper
- Evaluation- Benchmarking (where our solution stands)
- Decide to publish- which journal depends on our confidence and experience

How to Find Research Problems by Jason Eisner

- Cites Loren Eiseley, Biological Anthropologist
- Researchers are of two types
- Small bone Hunters
- Medium and Big bone hunters

Small bone hunters

- Small bone: Reproduce somebody's work/ state of the art in an understandable way
- Helps you to get educated and help the field of research also
- Small beginning: Tweaks for well known techniques
- Lookout for such bones while reading papers – find harmful simplifications/ assumptions /arbitrary choices/ missing proofs/ counter examples

Medium and Big Bone hunters

- Write a comprehensive Review which will enrich your knowledge and may give publicity. May become Chapter I of your thesis.
- Build a large program or tool (performance records, integration of existing techniques to build customized tool)
- If you are a co-author among many, make sure your distinct contribution somewhere.

Approach

- Flip through latest good conferences; try to know current crazy areas
- Example: Today talk of Cloud security, Big data, Data Mining, Privacy preserving data mining, IoT, AI, super computing, In-Memory computing, Cryptography etc
- Everybody now a days tries to use his expertise to spread into these fields
- For example - I look at opportunities in applications to cryptography, Analog ICs, Residue Number systems, Computer arithmetic, VLSI architectures for above areas

How to arrive at new problems?

- Read conclusions of papers
- Read suggestions for future work (the author may not do but may suggest).
- Analyze (think also) how to advance the state of the art (by studying limitations of previous solutions)
- Work on paper first (pen and pencil) –no tools – no simulation
- Weed out not so attractive ideas
- Useless ideas also are good- do not think as waste of time; you do not know unless you work out to find whether it is good or bad.
- Arrive at somewhat good or great idea. Then more detailed work – simulation, implementation, fabrication

Experiment/Simulation

- Experiment or simulation may show your idea may not meet the theoretical claims.
- Why? Non-idealities of components, inadequate modelling, include non-idealities to find deleterious effects, Monte-Carlo simulation
- You can sometimes state honestly– the deviation is due to …
- Honesty is best policy; even if you hide, reviewer may guess due to intuition, wisdom

Progress assessment

- Do not wait for very great solution
- Keep some goal- 80% of expectation reached- then send for publication
- Reviewers are gurus. Do not cry if paper is rejected. Read their comments, see where your work is deficient , improve and send to another journal
- Honest self assessment to know in which journal you can publish. (speed of review and acceptance)
- Shall I try for a brief or full paper? Size, depth of treatment, degree of novelty, self-assessment by comparison with previous work
- Do you want to submit to Conference? Then, if you submit paper, 60% difference may be needed- self plagiarism. Keep something for Thesis extra also.

One example

- Multiplier modulo 3329: X = (A×B) mod 3329
- Division and remainder computation
- Multiplication followed by Barrett reduction
- Montgomery multiplication
- Normal Multiplication followed by logic based reduction (Binary to residue conversion) using (3329=4096-3x256+1)
- Finding scaled answer KRED
- Finding K^2RED, KRED2X
- Can KRED etc be used for Dilithium prime (2^{23}-2^{13}+1)?

Solutions at different levels

- B.Tech student: read some book or browse internet. Get some solution. Implement and verify proper functionality, Submit to Indian College Conference
- M. Tech student: More literature survey, Evaluate some implemented design, Benchmark with other state of the art designs, little innovation, Indian Conference of higher level like VLSI design etc
- Ph. D student: More literature Survey, explore and introduce new designs/ ideas, thorough simulation/fabrication/ evaluation to prove the greatness of the deign, Submit Journal paper or IEEE reputed International conference

What to avoid

- Do not go for Quantity
- One good paper per year for one student in a good journal is great.
- Do not send to open access and paid journals.
- Do not cite these references also in your papers unless they are exceptionally good.
- Cite papers published very recently in last 3 years
- Choose indexing terms properly so that it will not go to wrong Associate Editors, Wrong reviewers.
- Avoid writing spoken English , thinking in Hindi or Tamil, Telugu , Punjabi and translating. Think in English.

Various steps-summary

- Choice of an area for research
- Choice of a topic in that area
- Matching of the researcher's skills to those needed to pursue that area
- Literature survey in chosen area
- Look at IEEE explore (includes IET) , Springer, Elsevier, World Scientific
- Find good review papers.
- Read conclusions of papers to see whether any suggestions for future work are given.

Matching of the researcher's skills to those needed to pursue that area

- C++, Java Programming
- MATLAB
- VHDL and VLSI, FPGA specific
- CAD/CAM
- Spectre RF for RF design
- Unless the area is 100% theoretical

Gap Analysis-Extensions

- Gap analysis (what is to be solved or discovered?)
- Sometimes extensions may be sheer scale- up of dimension. May not have great novelty but there is a need.
- Example: 32x32 bit multiplier, 256x256 bit multiplier but be sure about the application
- Readjust (acquiring new skills?)
- Picking up one gap (problem) and solve it within a short time

Periodic Progress assessment

- Relook at the problem (alternative problem)
- But maximum within three months take a decision.
- In general any area, improvement can be made.
- Consider: Can you publish three or four papers in that area in 3 to 4 years?
- Thesis has to be in only one area and not using disconnected topics.

Evaluation

- Benchmark your solution with state of the art solutions
- Be honest to say what is the advantage (at least in one respect) and what is the disadvantage.
- Do not wait for the best solution.
- Incremental improvements
- Learn good English

Submission and Review

- Choose (weigh the standard of your paper vis a vis a journal) a good journal
- Avoid open access journals (your standard will never improve)
- Submit your work to IEEE Transactions/ Electronics Letters/IET journals
- Wait for reviews to know what four or other five expert reviewers perceive your work
- Do not get disheartened
- Revise and resubmit to next level journal (Springer, Elsevier etc)
- Meanwhile work on another gap you have found.

Thesis writing

- Start after you have material for four or three Chapters other than Introduction and literature survey.
- When you start writing you will really do further research to fill up the gaps.
- Write Introduction in the end to suit your work being described in all the chapters.

How to publish technical papers?

Types

- Review paper
- Tutorial
- Research paper
- Journal or conference

Structure

- (a) Title (two lines maximum)
- (b) Authors' name (names); no degrees Dr, Prof. , Head etc shall not be written,
- only address in footnote, e-mail ID
- (c) Abstract: ten lines stating what is done in this paper. No big Introduction shall be included.
- Indexing terms after abstract give five or six

Structure

- (d) sections
- (i) Introduction
  (ii) preliminaries or notation etc
  (iii) review of previous work
  (iv) –(vii) Proposed techniques/Algorithms etc
  (viii) Simulation / experimental results
  (ix) Conclusion
  (x) References
  Appendices

Introduction

- Brief statement regarding relevance of the work (write in your own lines), previous approaches, limitations, motivation, rough outline of approach, organization of the paper Section II does this, Section III does this etc

- This is the most important part of the paper. Establish why one should read further?

preliminaries or notation etc

- This depends on the subject if too many symbols are used in the paper.
- Can be skipped otherwise

review of previous work

- Give historical account of the state of the art how it evolved.
- Benchmarks till today
- Give references to all statements made
- Limitations of earlier work
- What limitation you want to remove or what you want to improve
- Be honest
- Be up to date. Latest references 50% must be 2013 or 2012 unless you have discovered something after 20 years.
- Give good standard journal references: IEEE Transactions, ACM, not website urls or only not so good conference papers
- Refer to books also.

Proposed techniques/Algorithms etc

- This depends on your work. Check whether all symbols are explained in the text, all abbreviations expanded first time, References ordered properly, Equation numbers in order, any loose threads

Simulation / experimental results

- How have you tested your ideas.
- What tools used
- Details of experiments conducted
- How your results agree with your theory developed, % deviations
- Why deviations? due to what assumptions?
- Honest Comparison with earlier work: what improvement? what trade-off?

Conclusion

- State what have you researched, what have you concluded or improved? Any suggestions for future work by you or somebody else?

References

- [1] C. Toumazou, F. D. Lidgey, and D. G. Haigh, *Analog IC Design: The Current Mode Approach*. London, U.K.: Peregrinus, 1990.
- [2] P.V. Ananda Mohan**,** *Current-Mode VLSI Analog Filters: Design and Applications*, Birkhäuser Boston, 2003.
- [3]C. Tomazou, A. Payne and J. Lidgey, "Current feedback versus voltage feedback Amplifiers: History, insight and relationships", *Proc. ISCAS*, Chicago, U.S.A, vol 2, pp 1046-1049, 1993.
- [4]C. Toumazou and J. Lidge, "Current feedback op-amps: A blessing in disguise?," *IEEE Circuits Devices Mag.*, vol. 10, no. 1, pp. 34–37, 1994.
- [5] G. Palumbo and S. Pennisi, "Current-Feedback Amplifiers versus Voltage Operational Amplifiers", IEEE *Transactions on Circuits and Systems-I: Fundamental theory and Applications,* vol. 48, no.5, pp. 617-623, 2001.

References

- Some journals may want in a different style.
- References shall be Alphabetically arranged.
- Initials after name Lakshmi,P.
- Year after Name Lakshmi, P (2011), etc

General guidelines Journal Papers

- A4 size, single column
- 1.5 line spacing
- Font size 11
- Center the equations
- Put Page Numbers at right hand edge of page
- Sentences shall be small
- Use simple English
- Do not cut and paste from other papers or your own paper (self-plagiarism).

- Do not say “you may note that” . Say “ the reader may note that..”
- Do not say “I have investigated? Say “We have investigated and our results blah blah”
- Do not say “ He /She has observed that ..” Say “Wilson [ ] has observed that “ first time.
- “They have observed that..” is correct if more than one author is involved in that paper.
- Use et al. in place of giving list of Authors “ Ram, Lakshman, Bharat and Shatrughn have described..” Instead say Ram et al. [ ] have described. In reference, full list shall be given.

Conference papers

- Stick to template and size (number of pages).
- Figures shall be in place as near the place as they are referred.
- Font size comes automatically when you type in that area.
- Use Headings font size etc as in the template.

Conclusion

- Have passion to excel
- Follow the general guidelines
- All authors shall read independently the paper to know any improvements, loose threads etc.