



Research Methods in Science in Engineering

## Defending Your Research

Slide 1

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## Outline

- Introduction
- Ph.D. Dissertation Document
- Ph.D. Defense Presentation



Slide 2

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# Introduction

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## Purpose of the Dissertation

The dissertation is a complete summary of the research. It will include background, significance, novelty, methods, research, discussion of results, and future work. It should clearly justify that the degree is well deserved.

Things the committee must ensure:

- Is the topic and problem (or hypothesis) well defined and stated?
- Is the research new and novel enough?
- Is the research significant enough?
- Is the research difficult enough?
- Were the metrics for success satisfied?
- Was the research sufficiently disseminated?

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# Ph.D. Dissertation Document

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## Dissertation Outline

- Introduction Chapter
  - Problem statement or hypothesis
  - Novelty and significance
  - Research summary
  - Outline of document (optional)
- Background Chapters (May not be needed)
  - Cover everything a reader would need to know in order to understand your research.
  - Briefly summarize and cite information that is available elsewhere.
  - Go into detail about things not easily found in the literature.
- Methods Chapters
  - Describe the methods and tools you used for your research.
  - Cover only things that are not well covered in the literature.
- Research Chapters
  - Describe your research methods and results.
  - Likely copy/paste from your publications (watch copyright restrictions).
- Conclusion
  - Articulate what is significant and novel about your research.
  - Summarize your research and results.
  - Summarize your metrics for success and how you met them.
  - Discuss the meaning and impact that arises from your research.
  - Describe what future work could be done.
- Appendix/Appendices (optional)
  - Include any information or summaries that are helpful to your research or you want to have for later work.
  - Include any long and detailed derivations that would distract from the flow of the main document.



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## Things to Remember

- A dissertation tells a story. The document should hold the reader's hand and step them methodically through all aspects of the research.
- Start simple and explain the research at a high level, then fill in the details.
- Do not ever let the equations and figures do all the talking. Explain everything in the text.
- Cite each figure from the text before describing it. Talk the reader through the figure as if they are not able to see the figure.



## Example

The finite-difference method was used. See Fig. 7 for a summary.



The finite-difference method was used to solve Maxwell's equations and simulate the response of the diffraction gratings. This method was chosen due to its simplicity. The method as it was implemented in the present research is summarized in Figure 7. At a high level, the fields and materials are made discrete, allowing the derivatives in Maxwell's equations to be approximated with finite-differences. The finite-difference equations that come from this are written once for each point on the grid. This large set of finite-difference equations is expressed in matrix form. The matrix equations are algebraically combined to get a final matrix wave equation of the form  $\mathbf{A}\mathbf{f} = \mathbf{0}$ . Before a solution can be obtained, a source is incorporated using the total-field/scattered-field technique. When the source is incorporated, the matrix equation becomes  $\mathbf{A}\mathbf{f} = \mathbf{b}$  and is solved as  $\mathbf{f} = \mathbf{A}^{-1}\mathbf{b}$ . The column vector  $\mathbf{f}$  is reshaped to a 2D grid where it is visualized and post-processed to calculate overall transmittance  $T$  and reflectance  $R$ .

## Include an Appendix?

Consider including an appendix.

- Long derivations that distract from story of the dissertation.
- Extra information it would be nice to archive or have easy access to the future.
- Include research that ended up not being part of the main dissertation.



## Defense Document Template

Universities provide a template and/or formatting instructions for dissertations. You must follow them exactly.

University of Texas at El Paso

Thesis and Dissertation Formatting Guide

<https://www.utep.edu/cs/graduate/PDFs/thesis-dissertation-formatting-guidelines.pdf>

Thesis and Dissertation Template

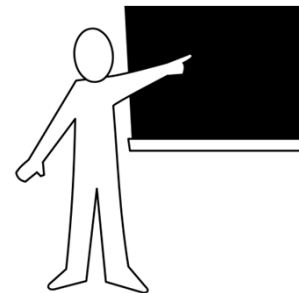
<https://www.utep.edu/graduate/Files/docs/forms/forms-for-masters-students/thesisdissertation-word-document.docx>

# Ph.D. Defense Presentation

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## Defense Presentation Outline

- Introduction
  - Topic of Dissertation (1 slide)
  - Significance and Novelty of the Research (1 slide)
  - Research Summary (1 slide)
  - Scientific Contributions (1 slide)
- Background
  - Provide 1-2 slide summaries of any background topics a person will need to understand your research.
  - State-of-the-Art. Summarize a comprehensive literature search.
- Research Summary
  - Scope & Objectives (1 slide)
  - Performance metrics (1 slide)
  - Research Methods (1 slide per method)
  - Tell story of your procedures, experiments and results (10's of slides)
- Conclusion
  - Summary: topic, significance, novelty, results and metrics (1 slide)
  - Future Work
  - Acknowledgements: funding source, committee members, etc.
  - Publications, posters & presentations (include pending and in progress)
  - References (if not provided on each slide)
- Appendix (Optional)
  - Include anything you wish to have on you to help answer questions.




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# Defense Presentation Template

A template for the proposal presentation is available on the EMPossible website:

<https://empossible.net/wp-content/uploads/2021/09/EMP-Research-Proposal-Presentation.pptx>

 Ph.D. Defense Meaningful Research Title Student: [Name] Committee: [Members]	<b>Proposal Outline</b> • Introduction • Problem statement (importance, significance and novelty of the research) • Background • Research Summary • Scope of objectives, research methods and results • Conclusion • Summary, future work and acknowledgments • List of publications, posters and presentations	<b>Introduction</b>	<b>Research Topic</b>	<b>Significance and Novelty of the Research</b>	<b>Research Summary</b>
<b>Scientific Contributions</b> • Build list (with pictures is preferred) • List every contribution that came from your research • What new knowledge did you generate by your research? • If contributions are shared by other researchers, acknowledge them	<b>Background</b>	[Topic #1]	<b>State-of-the-Art</b>	<b>Research Summary</b>	<b>Scope</b>
<b>Research Objectives</b>	[Research Method #1]	[Research Summary Slides]	<b>Be Sure to...</b> • Read other literature closely, and use large font • Cite your publications and other papers that justify your approach • Use tables and figures to communicate large sets of information or data • Use references to support conclusions, in-text • Be honest and confident about strengths, weaknesses, and limitations of your work • Remember that you are the focus of your presentation, not the slides	<b>Conclusion</b>	<b>Summary</b> • State your research topic/problem statement/opportunity • Highlight the significance and novelty of your research • Summarize your results along with quantitative performance metrics • Highlight list of the contributions and new knowledge you generated.
<b>Future Work</b>	<b>Acknowledgments</b>	<b>Publications, Posters, and Presentations</b>	<b>References</b>	<b>Appendix / Backup Slides</b>	[Topic #1]



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