School of Electronic Engineering

CB54: Machine Learning Algorithms for EM Wave Scattering Problems

Conference Paper

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Declaration

I hereby declare that, except where otherwise indicated, this document is entirely my own work and has not been submitted in whole or in part to any other university.

Signed: *Anthony James McElvee*   Date: 2023/08/20

Machine Learning Algorithms for EM Wave Scattering Problems

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Abstract – **This is the abstract. Sentences to include:** *This is a short, one-paragraph, description of the achievement. It might contain one sentence describing the problem and its importance, one sentence describing previous approaches and their deficiencies, one sentence describing the key principle behind the reported research, another describing the results obtained and a final sentence describing the value of what was achieved. 150 words max.*

Index Terms – *index term 1*

I. INTRODUCTION

This contains perhaps one paragraph describing the context of the problem under investigation, one describing the significance of the problem, one describing prior work and its merits and deficiencies, one describing your approach and the results obtained and another stating the value of the work. Expanding each of the sentences in your abstract into a paragraph will give you a good first draft of your introduction.

A. Task Motivation

The task motivation.

B. Problem Specification

The problem specification. [1] PERHAPS MOVE THIS TO TECHNICAL DESCRIPTION

II. PRIOR WORK & RELATION OF PRIOR WORK TO PROJECT PROBLEM

This is a survey of the state of the art. It should be more than a list of citations of prior work. Give this section a title relevant to your project ("Existing techniques for chronological displacement"). Organise prior work in groups and evaluate them. What are their common features, strengths and weaknesses? This section should be persuading the reader that there is a gaping hole in the research literature, and hint that the technique you are about to describe will fill that hole. The prior art on which you base this section will have already been discussed by you in your Literature Survey. However, you should have greater insight into prior research now, having completed your own project. Do not simply cut and paste text from your literature survey into this section rewrite it so that it is concise enough tomeet the length requirements of a research paper and to reflect your improved understanding of your research topic.
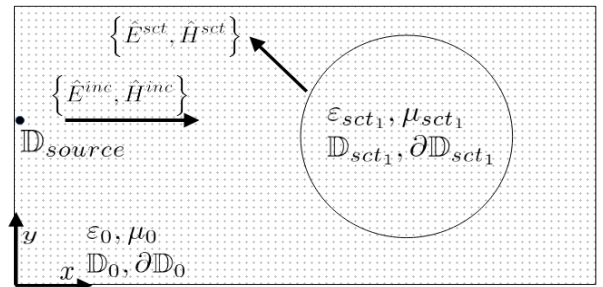**End of page 1**

Fig. 1 Problem Illustration. A single source emitting incident waves is located at a fixed x-axis location on the left-hand side of the scatter. Material values are complex valued, frequency-dependent permittivity (ε) and permeability (μ). Background points indicate discretization.

III.   TECHNICAL DESCRIPTION

Here you describe the technical approach you have taken in your project. This might include descriptions of algorithms, hardware designs, software architecture, methodologies, mathematical techniques, simulation models, or other facets of your design. Strive for clarity. Write a first draft of this section, print it out, and read it. Read it carefully. Does it make sense? No, it does not. Try to figure out what its flaws are. Now delete it and start over. Continually revising a poorly structured first draft of a description of your Great Idea will get you nowhere. Figure out what the structure should have been and write a second draft complying with that structure. Use consistent notation and terminology. If it was xi in the second paragraph, don't let it mutate into X by the end of the section. You can ensure this by deciding on notation and terminology before writing a word of this section. Make sure to present ideas in a logical order. Don't make the reader read ahead in the paper to find out what a quantum displacer is if you are using one in this paragraph, it should have been explained to the reader by now.

End of page 2 & 3

PUT IN AN ALGORITHMIC FLOW CHART LIKE IN [2] figure 1.

IV. RESULTS OBTAINED

Document your results here. Use tables and scatter plots, histograms, etc. to present numerical results. Make sure that the scenario used to obtain each set of results is described unambiguously. There should be sufficient information in this section and the previous one for the interested reader to replicate your results. Put some thought into how you visualise your results. If you generated lots of data, should it be presented in a 3D plot? On multiple 2D plots? What scales should use use? Log? Linear? If you use colour in your plots, will the traces still be distinguishable if printed in monochrome? Describe how you know your results are valid. What testing strategies were used? Were enough results obtained? Does your algorithm perform correctly? Does your code implement your algorithm accurately? Does your input data set contain features of the kind the algorithm is supposed to extract?

End of page 4

V. ANALYSIS

Interpret your results here. You've obtained lots of data. What have you learned from it? Does accepting transit traffic overload the router? What do the peaks in the spectral response indicate? Why are there no fluctuations in the EEG data? This section should be ONE PAGE in length. The division of the body of the report into three sections (here named "Technical Description", "Results Obtained" and "Analysis") may be inappropriate for some projects. If you wish to change this structure, you may do so only in consultation with your supervisor and only with his/her written agreement to the revised structure any suchrevised paper format must have an aggregate length of four pages for the sections equivalent to the above four.

End of page 5

VI. Conclusions

This is the conclusion. *Here you summarise what has been achieved and learned, and the implications for future research and suggestions for future work that could follow on from your work. This section resembles the introduction in some ways, but remember that by now the reader has read the body of the paper. The introduction was your attempt to encourage them to do so. You can present insights in the conclusions.*

References

[1]   C. Brennan and K. McGuinness, 'Site-specific Deep Learning Path Loss Models based on the Method of Moments'. arXiv, Feb. 02, 2023. doi: 10.48550/arXiv.2302.01052.

[2]   R. E. Meethal *et al.*, 'Finite element method-enhanced neural network for forward and inverse problems', *Advanced Modeling and Simulation in Engineering Sciences*, vol. 10, no. 1, p. 6, May 2023, doi: 10.1186/s40323-023-00243-1.