



Final Report

Research on Deep Learning Models: Determining the Optimal Cutting Parameters for a Microtome 710082147

3rd Year Individual Project

I certify that all material in this thesis that is not my own work has been identified and that no material has been included for which a degree has previously been conferred on me.

Signed.....Jiaqi Yao.....

College of Engineering, Mathematics, and Physical Sciences
University of Exeter

Final Report

ECM3175/ECM3149

Title: Research on Deep Learning Models: Determining the Optimal Cutting Parameters for a Microtome

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Abstract

This research demonstrates the innovative application of deep learning technologies in optimizing the cutting parameters of microtomes used in biomedical research. Our objective is to enhance the precision and efficiency of tissue sample preparation by utilizing Convolutional Neural Networks (CNN) to analyze tissue sections and determine optimal cutting conditions. The study integrates advanced image analysis and machine learning to evaluate the quality of tissue samples under various cutting angles, thereby improving the production of high-quality specimens for microscopic examination.

Our methodology includes collecting a comprehensive dataset of tissue samples, classifying sample quality using artificial image classification, and developing a CNN model to predict the best cutting parameters. The performance of the model was validated through empirical testing, showcasing significant improvements in tissue sample quality and laboratory workflows. This work promises to advance biological and medical sciences by simplifying the tissue sample preparation process and enhancing the quality of tissue sections in scientific research.

The results indicate that deep learning models, especially those pretrained on large datasets, are highly effective in identifying and classifying the quality of tissue sections, thus providing a robust framework for the automatic adjustment of microtome settings. This study not only deepens our understanding of the factors affecting tissue section quality but also proposes a concept for future research on automating biological sample preparation using machine learning.

*Keywords: Deep Learning Image Analysis Convolutional Neural Networks
Tissue Microtome*

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1. Introduction and background

Describe the background to the project.

This should introduce the topic; provide clear explanation of the aim, objectives and structure of the project. It should briefly identify plan of action for the project and identify any major assumptions or technical protocol or specifications adopted for the remainder of the project. It should also briefly introduce the format of the chapters and identify where the conclusions and recommendations are located.

1.1. *Example first subheading*

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2. Literature review

Describe what has been done in your specific topic by other people.

What has been done before?

How it shapes your project?

This must include precise information about the literature that was used to provide background information and to prepare the term of reference for the project. Concepts, conclusions and opinions taken from literature should be identified if they are later used in discussion or conclusions. All materials/ideas from other resources should be acknowledged by references.

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3. Methodology and theory

Description of the methods/techniques used including the building blocks for the research; all the methods for evaluating results and outcomes; and clear background for results (including math formulae)

This should briefly detail the activities and the plan adopted for the successful completion of the project aim and objectives. It should conclude problems encountered that affected the project original programme and identify how these problems have been overcome.

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4. Experimental work/analytical investigation/ design

Describe the design evolution of your project from conceptual, qualitative, quantitative, etc. analysis, experiments or design (hardware, software, procedure), design (of equipment or procedure).

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5. Presentation of experimental or analytical results/descriptions of final constructed product

A clear presentation of experimental and/or theoretical results obtained, highlighting any trends or points of interest. Provide a detailed, logical analysis of your results, and critically analyse your data. Discuss your findings in details.

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6. Discussion and conclusions

This section outlines a brief explanation of the significance and implications of the work reported, the general conclusions, and the recommendations for further work. It should summarise the conclusive points taken clearly and concisely from the previous chapters and from the results chapter or discussion sections of the previous chapters however structured.

- Description of what has been learnt from experimental/analytic at work or design
- Distillation of important findings and their significance
- Specific observations to inform future research

This is not the place to introduce new literature, discussion or conclusions points that have not been introduced, experimented, explored or validated in the previous chapters.

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7. Project management, consideration of sustainability and health and safety

Project plan as Gantt chart with tasks and milestones

Procedures and systems for project management

Researching, studying, and understanding the sustainability aspect of your project should be an important and vital part of your research. You should be able to demonstrate the process of identifying and mitigating environmental risk, the socio-economical impact of the project, demonstrating life-cycle analysis, recycling, carbon footprint, etc. It is expected that you undertake a professional approach when working on your project.

Provide details of the risk assessment (project related and health and safety) for your project. This should include a risk assessment and discuss the steps you took to mitigate risks.

Health and safety risk management is an important and vital part of each engineering project. You should be able to demonstrate the process of identifying hazards, estimating and prioritising risks, mitigating risks, and reviewing risks in the light of the progress of the project. It is expected that you undertake a professional approach when working on your project and that you follow the Health and Safety Guidelines of the College of Engineering, Mathematics, and Physical Sciences:

<https://student-harrison.emps.ex.ac.uk/index.php?nav=69>

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References

All materials/ideas from other resources should be acknowledged by references. The author-date system (Harvard Citation System) or the numerical system is preferable. Only one system should be applied in the report.

- [1] Insert references here – some example formats can be seen below
- [2] Buckley, PJ and Chapman, M (1996) "Theory and Method in International Business Research", International Business Review, 5(3), 233-245.
- [3] Oduoza, C.F. (1997) "Mass transfer in flow cells" Proc 5th IChemE Research Event, London, Institution of Chemical Engineers, 317-329.
- [4] Baker, J., The 68000 Microprocessor, <http://www.ex.ac.uk/~Jbaker/68000.html>, last accessed 25/08/2004.
- [5] ...