A Manuscript Microscope 'Sentence Audit' of:

Implementation and acceleration of optimal control for systems biology

What is the Manuscript Microscope Sentence Audit?

The Manuscript Microscope Sentence Audit is a research paper introspection system that parses the text of your manuscript into minimal sentence components for faster, more accurate, enhanced proofreading.

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Manuscript Source: https://www.biorxiv.org/content/10.1101/2021.03.17.435721v2

Manuscript Authors: Jesse A Sharp, Kevin Burrage & Matthew J Simpson

Audit Date: 31/03/21 **Audit Identifier:** 8O4M5A454LN853G **Code Version:** 3.6

Features of the Sentence Audit:

The Sentence Audit combines two complementary proofreading approaches:

1. Each sentence of your text is parsed and displayed in isolation for focused inspection.
2. Each individual sentence is further parsed into Minimal Sentence Components for a deeper review of the clarity, composition and consistency of the language you used.

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The combined approaches ensure easier, faster, more effective proofreading.

Comments and Caveats:

• The sentence parsing is achieved using a prototype natural language processing pipeline written in Python and may include occasional errors in sentence segmentation.

• Depending on the source of the input text, the Sentence Audit may contain occasional html artefacts that are parsed as sentences (E.g. "Download figure. Open in new tab").

• Always consult the original research paper as the true reference source for the text.

Contact Information:

To get a Manuscript Microscope Sentence Audit of any other research paper, simply forward any copy of the text to John.James@OxfordResearchServices.com.

All queries, feedback or suggestions are also very welcome.

Research Paper Sections:

The sections of the research paper input text parsed in this audit.

Section No.	Headings	Sentences
Section: 1	Abstract	8
Section: 2	1 Introduction	19
N/A	--- --- --- --- --- --- ---	0
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The Sentence Audit Of The Research Paper

Title # Implementation and acceleration of optimal control for systems biology

S1 [001] Abstract

S1 [002] Optimal control theory provides insight into complex resource allocation decisions.

Optimal control theory provides insight ...
... into complex resource allocation decisions.

S1 [003] The forward-backward sweep method (FBSM) is an iterative technique commonly implemented to solve two-point boundary value problems (TPBVPs) arising from the application of Pontryagin's Maximum Principle (PMP) in optimal control.

The forward-backward sweep method ...
... (FBSM) ...
... is an iterative technique commonly implemented ...
... to solve two-point boundary value problems ...
... (TPBVPs) ...
... arising ...
... from the application ...
... of Pontryagin's Maximum Principle ...
... (PMP) ...
... in optimal control.

S1 [004] In this review we discuss the PMP approach to optimal control and the implementation of the FBSM.

In this review we discuss the PMP approach ...
... to optimal control ...
... and the implementation ...
... of the FBSM.

S1 [005] By conceptualising the FBSM as a fixed point iteration process, we leverage and adapt existing acceleration techniques to improve its rate of convergence.

By conceptualising the FBSM ...
... as a fixed point iteration process, ...
... we leverage ...
... and adapt existing acceleration techniques ...
... to improve its rate ...
... of convergence.

S1 [006] We show that convergence improvement is attainable without prohibitively costly tuning of the acceleration techniques.

We show ...
... that convergence improvement is attainable ...
... without prohibitively costly tuning ...

... of the acceleration techniques.

S1 [007] Further, we demonstrate that these methods can induce convergence where the underlying FBSM fails to converge.

Further, ...
... we demonstrate ...
... that these methods can induce convergence ...
... where the underlying FBSM fails ...
... to converge.

S1 [008] All code used in this work to implement the FBSM and acceleration techniques is available on GitHub at https://github.com/Jesse-Sharp/Sharp2021.

All code used ...
... in this work ...
... to implement the FBSM ...
... and acceleration techniques is available ...
... on GitHub ...
... at ...
... https://github.com/Jesse-Sharp/Sharp2021.

S2 [009] 1 Introduction

S2 [010] Across the life sciences, we encounter systems over which we wish to exert control.

Across the life sciences, ...
... we encounter systems ...
... over ...
... which we wish ...
... to exert control.

S2 [011] Whether we consider outbreak control in epidemiology [1,54], chemotherapy in oncology [8,19,73], muscle contraction and gait regulation in biomechanics [31,45,61], engineering cellular processes in synthetic biology [27,39], cell population growth in tissue engineering [24,75], or biodiversity and invasive species management in ecology [9,20,22], we face decisions around how a particular intervention should be applied to best achieve desired outcomes.

Whether we consider outbreak control ...
... in epidemiology ...
... [1,54], ...
... chemotherapy ...
... in oncology ...
... [8,19,73], ...
... muscle contraction ...
... and gait regulation ...
... in biomechanics ...
... [31,45,61], ...
... engineering cellular processes ...

... in synthetic biology ...

... [27,39], ...

... cell population growth ...

... in tissue engineering ...

... [24,75], ...

... or biodiversity ...

... and invasive species management ...

... in ecology ...

... [9,20,22], ...

... we face decisions ...

... around how a particular intervention should be applied ...

... to best achieve desired outcomes.

S2 [012] Using mathematical models of such systems, optimal control theory provides insight into these resource allocation decisions.

Using mathematical models ...

... of such systems, ...

... optimal control theory provides insight ...

... into these resource allocation decisions.

S2 [013] Optimal control is a science of trade-offs; between competing objectives, or in weighing up the benefits of control measures against their costs.

Optimal control is a science ...

... of trade-offs; ...

... between competing objectives, ...

... or in weighing up the benefits ...

... of control measures ...

... against their costs.

S2 [014] We illustrate some key concepts of optimal control in Figure 1. Suppose that without intervention, a crop yield will double, from x0 to 2x0, between now and harvest time.

We illustrate some key concepts ...

... of optimal control ...

... in Figure 1. Suppose ...

... that ...

... without intervention, ...

... a crop yield will double, ...

... from x0 ...

... to 2x0, ...

... between now ...

... and harvest time.

S2 [015] We might consider applying a control, such as fertiliser, to increase the growth rate of the crop; thereby increasing the yield at harvest to 3x0.

We ...

... might consider applying a control, ...

... such as fertiliser, ...

... to increase the growth rate ...

... of the crop; ...

... thereby increasing the yield ...

... at harvest ...

... to 3x0.

S2 [016] Of course, applying fertiliser comes at a cost, and this must be considered against the increase in crop yield.

Of course, ...

... applying fertiliser comes ...

... at a cost, ...

... and this must be considered ...

... against the increase ...

... in crop yield.

S2 [017] As such, it is not immediately apparent how much fertiliser should be applied, and over what time period.

As such, ...

... it is not immediately apparent how much fertiliser should be applied, ...

... and ...

... over what time period.

S2 [018] This depends entirely on our characterisation of optimality; the pay-off.

This depends entirely ...

... on our characterisation ...

... of optimality; ...

... the pay-off.

S2 [019] Depending on the pay-off, the optimal control may be continuous; whereby the strength can be readily and continuously adjusted throughout time, or bang-bang (discontinuous); whereby the control is applied at either a lower or upper bound with finitely many discrete switches between the two.

Depending ...

... on the pay-off, ...

... the optimal control ...

... may be continuous; ...

... whereby the strength can be readily ...

... and continuously adjusted ...

... throughout time, ...

... or bang-bang ...

... (discontinuous); ...

... whereby the control is applied ...

... at either a lower ...

... or upper bound ...

... with finitely many discrete switches ...

... between the two.

S2 [020] The pay-off determines the objective(s) of control; which in our stylised example may be to maximise profits after cost of fertilising is considered, or achieve a specific yield, for example 3x0, using the minimum amount of fertiliser.

The pay-off determines the objective(s) ...

... of control; ...

End of Sample Audit

This is a truncated Manuscript Microscope Sample Audit.

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