Writing and LaTeX Tips for the AERO-CORE Lab

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The flying and handling qualities of a Small-scale Supersonic Uncrewed Aerial Vehicle (SSUAV) are analyzed to facilitate future SSUAV design and experimental testing. For this goal, the flying qualities of an experimental Multipurpose Uncrewed Fixed-wing Advanced Supersonic Aircraft (MUFASA) SSUAV are assessed. A continuous handling quality evaluation is proposed and implemented across the SSUAV's flight regime, providing a new flight trajectory optimization method. The results highlight that the mean handling qualities of the targeted SSUAV range from acceptable to controllable in the transonic flight regime and controllable in the subsonic regime. Finally, SSUAVs were compared to small-scale UAVs and full-scale supersonic aircraft, exhibiting much higher roll-rates. When attitude rates are normalized, SSUAVs exhibit roll behavior in line with small-scale UAVs but pitch behavior in line with full-scale supersonic aircraft. SSUAVs pose unique handling quality challenges that combine elements of small-scale UAVs and large-scale supersonic aircraft.

Contents

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I. Nomenclature

The nomenclature should be laid out according to the journal/conference/university requirements. Common nomenclatures sections include: Abbreviations, Symbols, Greek Symbols, Roman Symbols, Subscripts, and Superscripts. Within each of these nomenclature sections, symbols are organized alphabetically.

Symbols

C_D, C_L, C_Y	=	drag, lift, and lateral force coefficient
C_F	=	skin friction coefficient
C_l, C_m, C_n	=	roll, pitch, and yaw moment coefficient
c_{mean}	=	mean aerodynamic chord, m
$\mathbf{F}_{\text{aero}}$	=	aerodynamic force vector along the body axes, N
$\mathbf{F}_g$	=	force of gravity vector, N
$\mathbf{F}_{\text{net}}$	=	total force vector, N
$\mathbf{F}_T$	=	force vector of engine thrust, N

Greek Symbols

α	=	angle of attack, rad
β	=	angle of sideslip, rad
$\delta_a, \delta_e, \delta_r$	=	control surface deflections, rad

Subscripts

0	=	nominal coefficient

II. Writing

This section outlines advice, tips, and suggestions to consider when writing. The writing instruction provided is in no way conclusive, however, it is the author's hope that it will be developed through time to ease students into the expectations of academic writing.

A. Document Setup

The most important thing to consider before even beginning to write is what are the expectations? Every technical writing conference/journal/thesis will have a set of formatting requirements [1, 2]. Review these requirements **before** writing to save time later re-formatting everything that was incorrect initially. These organizational formatting requirements are the be-all-end-all to discussions about formatting, the document must align.

1. Figures and Tables

General rules exist that apply to both figures and tables. A couple of these shared rules are listed:

- Figures and tables must always be introduced in-text before they are presented,
- Figures and tables should not have titles,
- Figure and table text should match document size and font,
- Captions should remain within the margins of the figure/table they describe,
- Captions should end with a period (as they are a proper sentence).

Specific figure considerations include:

- Colour should be chosen in such a way that data will still be differentiable in greyscale,
- Gradient colour should start/end light/dark, not have white in the middle of the gradient as this could become confusing in greyscale, an example of gradients is presented in Fig. 1,
- Ideally, different data marks should be utilized to ensure data is differentiable in greyscale,
- Colour choice should be considerate of colourblind people [3],
- Axes should end on definitive numbers.

Examples of these aforementioned rules are presented in Fig. 1 and 2.

B. General Writing

Common writing mistakes and misconceptions are presented in this section. It is the authors hope this list is useful, not to mention also not containing errors of its own. Great resources are found online [1], and at the University of Calgary [4, 5].

1. Language

A conference/journal/thesis requires exact language be used. Using words such as *can*, *could*, and *would* make the document sound uncertain. This type of uncertain wording should only be used when discussing potential future work, which is always inherently uncertain. Do not write "*...this can be seen in Fig...,*", instead write "*...this is presented in Fig...*".

A word on the use of the word *this*. The word *this* should not start a sentence unless it is followed directly with

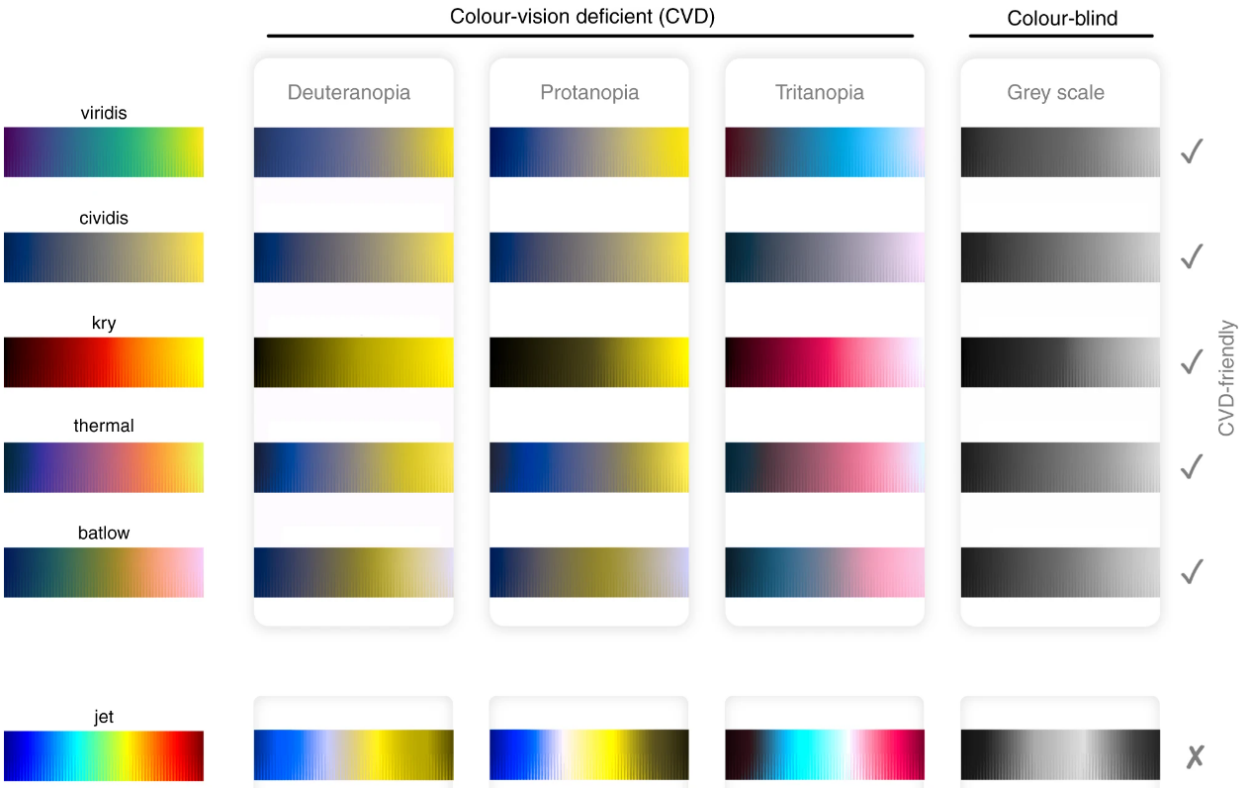

Fig. 1 How common gradients appear to various colourblind diagnoses, adapted from Crameri et al. [3].

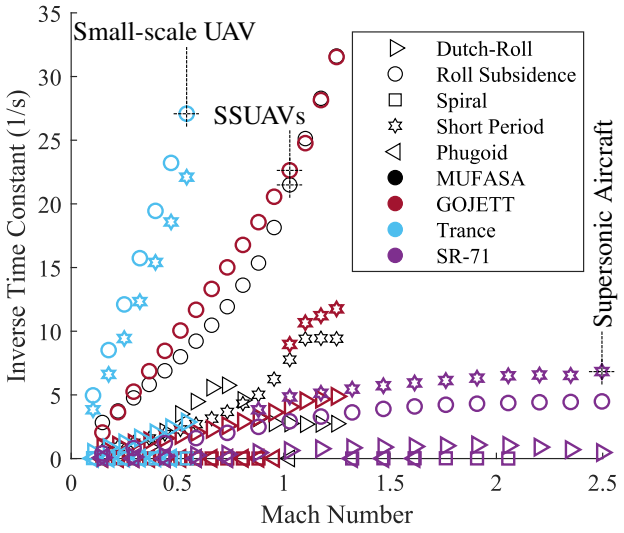

Fig. 2 MUFASA B aerodynamic design and coordinate system. Notice how different symbols and colours are used. Also note how the ends of the x and y axes are denoted by a number and not left ambiguously floating.

an indication of what *this* is. A sentence should be a standalone idea, thus, without reiterating to the reader what *this* is, it is very easy for the reader to become confused. Parallel to this concept of the uncertainty of *this* is how authors sometimes use *it* without explaining what *it* is they are referring to.

Word choice is paramount and matters. While often used interchangeably in normal language, *compute*, *evaluate*, and *calculate* suggest very different approaches were taken.

2. Commas

Always use the Oxford comma when making a list. The Oxford comma helps the reader understand if the last two items in a list are together or separate.

C. Referencing

Referencing is a vital part of science, a way to track that all scientific statements are supported by evidence [6].

III. LaTeX Coding Best Practices

This section outlines some key coding functions that are extremely helpful when working with LaTeX.

A. Internal Document Referencing

LaTeX automatically handles referencing using its built in `\ref{}` or the often preferred *cleveref* userpackage `\cref{}`. How referencing works is a `\label{}` is placed at a section title (`\label{sec:}`), in an equation (`\label{eqn:}`), in a table (`\label{tab:}`), or in a figure (`\label{fig:}`). With a label in place, say in Fig. 3, the Cleveref is used to add a reference in text. For example, Fig. 3 is labelled *fig:mufasaB2*, so to reference it in-text the code is `\cref{fig:mufasaB2}`.

B. Citations

Always check the style and expected format of references for the journal/conference/university the paper will be submitted to. When citing, ensure the bibtex file has all the required information to be displayed according to the journal/conference/university requirements. An example bibtex entry for work by Durante [7] is provided as follows:

```
@mastersthesis{BenThesis,
author = {Durante, Benjamin Joseph},
pages = {1--128},
school = {University of Calgary]},
title = {Flying and Handling Qualities of Small-Scale Supersonic Uncrewed Aerial Vehicles},
note = {{Avaliable: \url{https://dx.doi.org/10.11575/PRISM/40789}}},
type = {{[Master's} Thesis},
```

```
year = {2023}
}
```

Additional BibTex entry formats are found online, with common types being `@article{}`, `@inproceedings{}`, `@techreport{}`, `@phdthesis{}`, `@book{}`, and `@misc{}`.

Based on the BibTex identification name (ex. *BenThesis* above) references are easily cited in-text and added to the bibliography. Multiple commands are used to automatically cite a work depending on the presentation desired:

- `\cite{BenThesis}` cites the text numerically as follows: [7],
- `\citep{BenThesis}` acts very similarily to the previous command in IEEE and AIAA as follows: [7], however this command behaves differently with the APA citation style,
- `\citeauthor{BenThesis}\cite{BenThesis}` automatically fills in the authors name and then adds the numerical reference, automatically linking both, as follows: Durante [7].

C. Diagram Creation

Diagrams should appear crisp, ideally they are vector files meaning they can be infinitely zoomed in without getting blurry. Diagram text should align with the document text exactly. One way to ensure diagram text always matches the LaTeX document text is by creating the diagrams in InkScape. The diagram creation video is outlined in the following YouTube video: `https://youtu.be/NbHKJNMsYqE?si=W-XXTR8T_Izss_j1`. Note, this YouTube example only works for InkScape Version 1.1 (`https://inkscape.org/release/inkscape-1.1/?latest=1%29`).

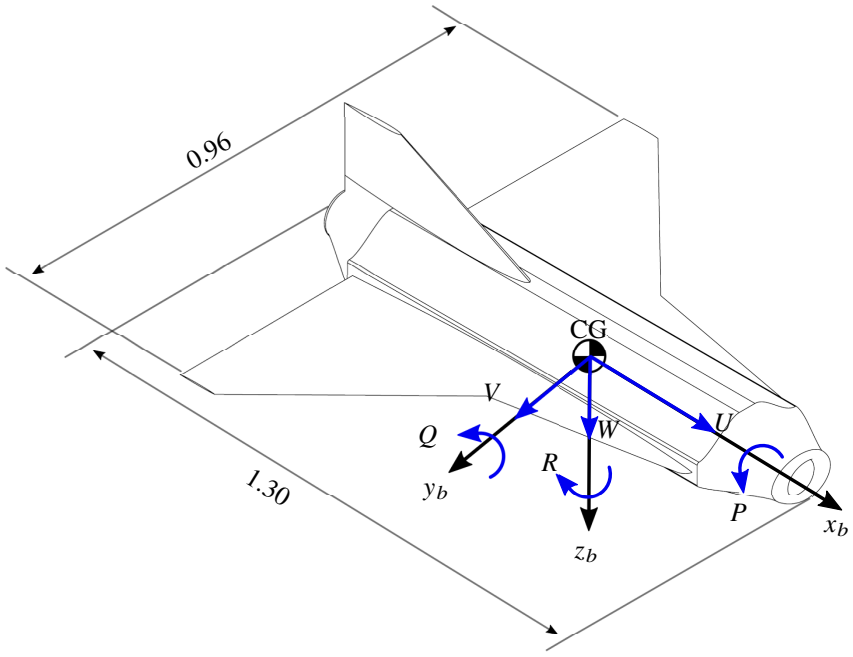

Fig. 3 MUFASA B aerodynamic design and coordinate system.

This type of figure is generated using the following commands:

```
\begin{figure}[hbt!]
\centering
\captionsetup{width=0.7\textwidth}
%\includegraphics[width=0.7\textwidth]{Photos/MUFASA/MUFASA-ISO-Frames-BodyLength.png}
\def\svgwidth{0.7\textwidth}
\input{Photos/MUFASA/MUFASA-ISO-Frames-BodyLength.eps_tex}
\caption{MUFASA B aerodynamic design and coordinate system.}
\label{fig:mufasaB2}
\hfill
\end{figure}
```

D. Equations

When coding an equation, carefully consider what is a variable and what is a label. Variables should be in math text, while labels should be in regular text. For example, in Eq. 1, F_{net} is net force, not force as a function of variables $n \times e \times t$. Regular text can be inserted into an equation via the `\text{}` command.

$$F_{\text{net}} = F_{\text{aero}} + F_{\text{g}} + F_{\text{T}} \tag{1}$$

E. Figure Creation

F. Custom Variable Creation

Local document variables are a way to aid in typing repetitive words or numerical values. These custom variables also aid in document consistency when referring to repeated words or values. An example of using locally defined document variables is creating a command to represent the word *ArduPilot*. Due to the letters in *ArduPilot*, it is an awkward word to type and a coding shorthand is created using the command: `\newcommand{\ap}{ArduPilot}`. Now, by typing `\ap\`, the word ArduPilot is seamlessly inserted into the text. Note that the `\` following the `\ap` indicates a space should be left following the word ArduPilot.

LaTeX variables also work when inserted into InkScape generated figures, as outlined in the following YouTube video: `https://youtu.be/r0G44lxhTwc?si=SVSKCUj6mTy4rGCN`. Using variables in a diagram increases writing efficiency as it reduces the need to manually regenerate diagrams to change a variable when using the workflow presented in Section III.C.

Acknowledgments

Funding for this work was provided by the AERO-CORE research group.

References

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[3] Crameri, F., Shephard, G. E., and Heron, P. J., "The misuse of colour in science communication," *Nature communications*, Vol. 11, No. 1, 2020, p. 5444.

[4] Student Success Centre, "Writing Support," Retrieved from: https://www.ucalgary.ca/student-services/student-success/writing-support, 2023.

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[7] Durante, B. J., "Flying and Handling Qualities of Small-Scale Supersonic Uncrewed Aerial Vehicles," [Master's thesis, University of Calgary], 2023. Avaliable: https://dx.doi.org/10.11575/PRISM/40789.