Interactive Visualization of Neural Networks

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ABSTRACT

A clear and well-documented LaTeX document is presented as an article formatted for publication by ACM in a conference proceedings or journal publication. Based on the "acmart" document class, this article presents and explains many of the common variations, as well as many of the formatting elements an author may use in the preparation of the documentation of their work.

KEYWORDS

neural networks, visulization, interactive

ACM Reference Format:
Zijian Li, Callin Switzer, Yue Zhao, and Zhengde Zhao. 2019. Interactive Visualization of Neural Networks. In *Proceedings of ACM Conference (Conference'17).* ACM, New York, NY, USA, 3 pages. https://doi.org/10.1145/nnnnnnn.nnnnnnn

1 INTRODUCTION

Background

Moths have very simple brain, but they are capable with precise and subtle flying maneuvers. They generate locomotor force by activating the flight muscles to move their wings, and the aerodynamic forces and torques it generates enable they to preform various flying behaviors including fast forward, odor plume tracking, hovering in front of flowers, decelerating upon approach and conpensating for enrionmental perturbations [7] [10] . To understand how moths control their flight is already by itself interesting, not to mention that bio-inspired flapping wings system has potential application to micro air vehicles according to Chen in [1].

[Picture of a realistic Moth]

Multiple recent researchers has targeted this question. In [3], the authors treated this question as an inverse problem, where the input of the system is the initial position, initial velocity targeting position and targeting velocity while the output of the system is the wing motion. They developed an aerodynamic model illustrating how a particular motion in the wings of a moth could result in a kinetic motion. In [2], they found that not only the wings but also the shape of the body plays an important role in a moth's flight control. New variables such as the angle of the body of the moth were introduced into the model. Further study has also shown that structural deformation also affects flapping wing energetics, see [4]. Nevertheless, to solve the inverse problem of flight control is intrinsically difficult. It involves solving a highly nonlinear dynamically system.

On the other side, people has developed theory to solve dynamical systems with machine learning techniques. For example see [9]. Moreover, recent study show some very successful examples in solving model based motion control problem with deep learning neural networks. For instance, see [5] and [8] for legged robot locomation and [6] for aggresive control of autonomous quadrotors. With these successes, people are also looking into such a deep learning solution to the dynamical system of moth flight control.

Neural Network & Visualization

Dr. Switzer, a researcher in the Biology Department of University of Washington, and his colleagues developed several deep learning neural networks in order to solve the moth flight control problem. More specifically, they want to know the following. Suppose I am a moth and I know where I am and where I want to go, how do I get there? To answer this, they first built up a virtual moth. With this virtual moth, they simulated a dataset consisting of the actions the moth is taking and its resulting kinetic motion. After that, they trained several different neural networks, with different scales, using this dataset and lastly they evaluated the predictions by the neural network. It turns out that the best of their model is able to recreate a large share of the variance of the dependent variables in this model, with $r^2 > 0.999$.

[Picture as PPT page 10]
[Picture prediction result]

Now with these neural networks, we are able to generate an action for a particular intended motion that a moth is to

Conference'17, July 2017, Washington, DC, USA

ACM ISBN 978-x-xxxx-xxxx-x/YY/MM...$15.00
https://doi.org/10.1145/nnnnnnn.nnnnnnn

Table 1: Frequency of Special Characters

Non-English or Math	Frequency	Comments
Ø	1 in 1,000	For Swedish names
π	1 in 5	Common in math
$	4 in 5	Used in business
Ψ_1^2	1 in 40,000	Unexplained usage

take. The next step is to see how meaningful information we are able to extract from this neural network solution.

2 INTERACTION

The "`acmart`" document class requires the use of the "Libertine" typeface family. Your TeX installation should include this set of packages. Please do not substitute other typefaces. The "`lmodern`" and "`ltimes`" packages should not be used, as they will override the built-in typeface families.

3 TITLE INFORMATION

The title of your work should use capital letters appropriately - https://capitalizemytitle.com/ has useful rules for capitalization. Use the `title` command to define the title of your work. If your work has a subtitle, define it with the `subtitle` command. Do not insert line breaks in your title.

If your title is lengthy, you must define a short version to be used in the page headers, to prevent overlapping text. The `title` command has a "short title" parameter:

```
\title[short title]{full title}
```

4 TABLES

The "`acmart`" document class includes the "`booktabs`" package — https://ctan.org/pkg/booktabs — for preparing high-quality tables.

Table captions are placed *above* the table.

Because tables cannot be split across pages, the best placement for them is typically the top of the page nearest their initial cite. To ensure this proper "floating" placement of tables, use the environment **table** to enclose the table's contents and the table caption. The contents of the table itself must go in the **tabular** environment, to be aligned properly in rows and columns, with the desired horizontal and vertical rules. Again, detailed instructions on **tabular** material are found in the *LaTeX User's Guide*.

Immediately following this sentence is the point at which Table 1 is included in the input file; compare the placement of the table here with the table in the printed output of this document.

To set a wider table, which takes up the whole width of the page's live area, use the environment **table*** to enclose the table's contents and the table caption. As with a single-column table, this wide table will "float" to a location deemed more desirable. Immediately following this sentence is the point at which Table is included in the input file; again, it is instructive to compare the placement of the table here with the table in the printed output of this document.

5 FIGURES

The "`figure`" environment should be used for figures. One or more images can be placed within a figure. If your figure contains third-party material, you must clearly identify it as such, as shown in the example below.

Figure 1: 1907 Franklin Model D roadster. Photograph by Harris & Ewing, Inc. [Public domain], via Wikimedia Commons. (https://goo.gl/VLCRBB).

Your figures should contain a caption which describes the figure to the reader. Figure captions go below the figure. Your figures should **also** include a description suitable for screen readers, to assist the visually-challenged to better understand your work.

Figure captions are placed *below* the figure.

The "Teaser Figure"

A "teaser figure" is an image, or set of images in one figure, that are placed after all author and affiliation information, and before the body of the article, spanning the page. If you wish to have such a figure in your article, place the command immediately before the `\maketitle` command:

```
\begin{teaserfigure}
 \includegraphics[width=\textwidth]{sampleteaser}
  \caption{figure caption}
  \Description{figure description}
\end{teaserfigure}
```

6 SIGCHI EXTENDED ABSTRACTS

The "`sigchi-a`" template style (available only in LaTeX and not in Word) produces a landscape-orientation formatted article, with a wide left margin. Three environments are available for use with the "`sigchi-a`" template style, and produce formatted output in the margin:

- `sidebar`: Place formatted text in the margin.
- `marginfigure`: Place a figure in the margin.
- `margintable`: Place a table in the margin.

ACKNOWLEDGMENTS

To Robert, for the bagels and explaining CMYK and color spaces.

Table 2: Some Typical Commands

Command	A Number	Comments
`\author`	100	Author
`\table`	300	For tables
`\table*`	400	For wider tables

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A RESEARCH METHODS

Part Two

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B ONLINE RESOURCES

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