

LaTeX Example

Your Name*

Raúl Ordóñez[†]

Abstract

This is a brief example that illustrates the use of LaTeX for the purpose of producing technical papers with journal-quality layout. You should look at the source file and compare it with the output to understand how each command is used and what it does. Using LaTeX is typically difficult at the beginning, but it becomes easier as you continue using it. This example assumes that you are operating in a Unix environment, but doing LaTeX on a PC or Mac is easily accomplished by following the specific instructions of the LaTeX implementation you are using.

1 Files included

There is this file, `EXAMPLE.TEX`, the files `COMMANDS.TEX`, `RESEARCHBIB.BIB` and `DAC_WING_ROCK_X12.EPS`.

Here is what to do with them:

1.1 `example.tex`

Create a directory somewhere, and dedicate it to this file. You could call it `latexexample`. Put `EXAMPLE.TEX` in there.

1.2 `commands.tex`

Create a directory called `tex/inputs` in your home directory and put this file in there.

1.3 `researchbib.tex`

Create a directory called `tex/bib` in your home directory and put this file in there.

*University of Control (you@control.edu).

[†]Dept. of Electrical and Computer Engineering, University of Dayton, 300 College Park, Dayton, OH 45469-0226, U.S.A., Phone: (937) 229-3183, E-mail: raul.ordonez@notes.udayton.edu

1.4 Environmental variables

In a Unix system, in your shell start-up file (`.BASHRC` in `bash`), set two environmental variables:

1. `export TEXINPUTS=/export/home/staff/ordonez/tex/inputs:
/opt/texmf/tex//:/opt/texmf/tex/plain//:.`
2. `export BIBINPUTS=/export/home/staff/ordonez/tex/bib:/opt/texmf/bibtex/bib//:.`

Change the absolute references to my home directory to your own path, as well as the references to latex's location (if not under `/opt`, latex is typically installed under `/usr/local`).

In a windows or Mac installation of latex the procedure is similar, but please refer to the instructions that come with the installation.

2 Compiling the file

Go to the directory where you have the example file and run

```
latex example
bibtex example
latex example
latex example
```

You have to do it like this so that the bibliographical reference is correctly set. Next, to view the file, run

```
xdvi example &
```

To produce postscript, use

```
dvips -o example.ps example
```

Under windows and Mac there are equivalent commands to run latex and bibtex (which takes care of bibliographical references in your paper), as well as to preview your output. Note that you only need to keep *one* file containing your references database. Every paper you write uses the same database to include the citations needed.

3 Some Math Examples

An equation:

$$F(s) = \int_0^{\infty} f(t)e^{-st} dt \quad (1)$$

An array of equations:

$$\begin{aligned} f(t) &= 1 + \frac{t+1}{t^2+2t-5} \\ g(t) - f^2(t) &= \cos(3t - \sigma) + \alpha - \beta + \frac{\partial f(t)}{\partial t} \end{aligned} \quad (2)$$

The command “notag” in (2) makes it so that only one number is assigned to the array. Here is a list of items:

- Item 1 with an in-line equation: $b = \sum_{j=1}^{\infty} \frac{c_j}{e^{j\theta}}$.
- Item 2 with an unnumbered equation

$$G(s) = \frac{(s+2)^2(s-1)}{s^3(s-5)(s+5)} \leftarrow \text{an example of a linear, unstable system}$$

- A matrix equation:

$$\dot{x} = \begin{bmatrix} 1 & 2 \\ c+d & 3 \\ 4 & \sqrt{2^2} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} \quad (3)$$

Here are some more equations, a theorem (taken from [1]) and its proof:

This is the plant

$$\begin{aligned} \dot{x}_i &= \sum_{j=1}^R \rho_j(v) \left(\phi_i^j(X_i) + \psi_i^j(X_i)x_{i+1} \right) \\ \dot{x}_n &= \sum_{j=1}^R \rho_j(v) \left(\phi_n^j(X_n) + \psi_n^j(X_n)u \right) \end{aligned} \quad (4)$$

and this is an assumption

$$\sum_{j=1}^R \rho_j(v) < \infty. \quad (5)$$

and another assumption

$$\begin{aligned} \phi_i^c(0, v) &= 0 \\ \psi_i^c(X_i, v) &\neq 0. \end{aligned} \quad (6)$$

and the last assumption.

$$0 < \underline{\psi}_i^c \leq \psi_i^c(X_i, v) \leq \bar{\psi}_i^c < \infty$$

$$\left| \dot{\psi}_i^c \right| = \left| \sum_{j=1}^R \left(\frac{\partial \rho_j(v)}{\partial v} v \psi_i^j(X_i) + \rho_j(v) \frac{\partial \psi_i^j(X_i)}{\partial X_i} \dot{X}_i \right) \right| \leq \psi_{i_d}^c. \quad (7)$$

Now we present the stability theorem

Theorem 1: Consider system (4) with the state vector X_n measurable and the scheduling vector ν_{n-1} measurable and bounded, together with assumptions (5), (6) and (7). Assume also that $\nu_i(0) \in \mathcal{S}_{\nu_i} \subset \mathbb{R}^{q \times i}$, $X_i(0) \in \mathcal{S}_{x_i} \subset \mathbb{R}^i$, $i = 1, \dots, n$, where \mathcal{S}_{ν_i} and \mathcal{S}_{x_i} are compact sets specified a priori, and large enough that ν_i and X_i do not exit them. Consider the diffeomorphism

$$z_1 = x_1$$

$$z_i = x_i - \hat{\alpha}_{i-1} - \alpha_{i-1}^s, \quad i = 2, \dots, n, \quad (8)$$

with ($i = 1, \dots, n$)

$$\hat{\alpha}_i(X_i, \nu_i) = \sum_{j=1}^R \rho_j(v) \hat{\theta}_{\alpha_i^j}^\top \zeta_{\alpha_i^j}(X_i, \nu_i)$$

$$\alpha_i^s(z_i, z_{i-1}) = -k_i z_i - z_{i-1}, \quad \text{with } k_i > 0 \text{ and } z_0 = 0. \quad (9)$$

Assume the functions $\zeta_{\alpha_i^j}(X_i, \nu_i)$ to be at least $n-i$ times continuously differentiable, and to satisfy, for $i = 1, \dots, n$, $j = 1, \dots, R$,

$$\left| \frac{\partial^{n-i} \zeta_{\alpha_i^j}}{\partial [X_i, \nu_i]^{n-i}} \right| < \infty. \quad (10)$$

Consider the adaptation laws for the parameter vectors $\hat{\theta}_{\alpha_i^j} \in \mathbb{R}^{N_{\alpha_i^j}}$, $N_{\alpha_i^j} \in \mathbb{N}$,

$$\dot{\hat{\theta}}_{\alpha_i^j} = -\rho_j \gamma_{\alpha_i^j} \zeta_{\alpha_i^j} z_i - \sigma_{\alpha_i^j} \hat{\theta}_{\alpha_i^j} \quad (11)$$

with $\gamma_{\alpha_i^j} > 0$, $\sigma_{\alpha_i^j} > 0$, $i = 1, \dots, n$, $j = 1, \dots, R$. Then, the control law

$$u = \hat{\alpha}_n + \alpha_n^s \quad (12)$$

guarantees boundedness of all signals and convergence of the states to the residual set

$$\mathcal{D}_d = \left\{ X_n \in \mathfrak{R}^n : \sum_{i=1}^n z_i^2 \leq \frac{2\underline{\psi}_m W_d}{\beta_d} \right\}. \quad (13)$$

where $\underline{\psi}_m = \min_{1 \leq i \leq n} \bar{\psi}_i^c$, β_d is a constant, and W_d measures approximation errors and ideal parameter sizes, and its magnitude can be reduced through the choice of the design constants k_i , $\gamma_{\alpha_i^j}$ and $\sigma_{\alpha_i^j}$.

Proof: The proof requires n steps, and is performed inductively. First, let $z_1 = x_1$, and $z_2 = x_2 - \hat{\alpha}_1 - \alpha_1^s$, where $\hat{\alpha}_1$ is the approximation to an ideal signal α_1^* (“ideal” in the sense that

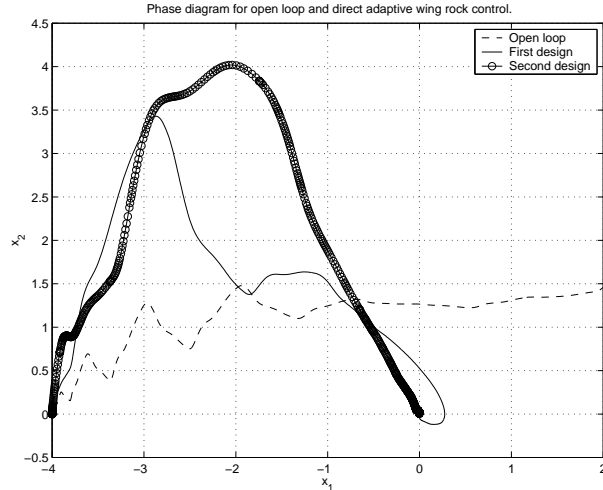


Figure 1: This is a figure. It can be in eps, pdf or even jpeg and tiff formats, but note that it is not necessary to write the extension of the file.

if we had $\hat{\alpha}_1 = \alpha_1^*$ we would have a globally asymptotically stable closed loop without need for the stabilizing term α_1^s), and α_1^s will be given below. Let $c_1 > 0$ be a constant such that $c_1 > \frac{\psi_1^c d}{2\underline{\psi}_1^c}$, and

$$\alpha_1^*(x_1, v) = \frac{1}{\psi_1^c} (-\phi_1^c - c_1 z_1). \quad (14)$$

The rest of the proof has been omitted because of space constraints¹. □

Finally, Figure 1 contains a plot and the corresponding commands in the source file show how to include a plot. This is the most basic way, and there are other possibilities. Note that LaTeX takes care of positioning the figures and, most importantly, of numberings and cross-references for figures, tables and equations.

This was a very brief introduction to some of Latex’s capabilities.

4 Conclusions

We note that latex is like a programming language, with many commands to learn, but it produces beautiful layouts and is very powerful once mastered.

References

- [1] R. Ordóñez and K. M. Passino, “Adaptive control for a class of nonlinear systems with a time-varying structure,” *IEEE Transactions on Automatic Control*, vol. 46, pp. 152–155, Jan. 2001.

¹Here is a footnote.