An Example Article

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Abstract

This is an example LaTeX article. This can be used as a template for new articles. Abstracts must be able to stand alone and so cannot contain citations to the paper's references,equations, etc. An abstract must consist of a single paragraph and be concise. Because of online formatting, abstracts must appear as plain as possible. Any equations should be inline.

Keywords: Example, LaTeX, numerical methods

Mathematics Subject Classification: 65M60, 65M12.

1. Introduction

The introduction introduces the context and summarizes the manuscript. It is important to clearly state the contributions of this piece of work.

In this paper we present a new method for solving the model equation

$$\begin{cases} \partial_t u - \varepsilon^2 \Delta u + u^3 - u = 0, \quad \text{in } \Omega \times \mathcal{T}, \\ u(x,y,t) = g(t), \quad \text{on } \partial\Omega, \\ u(x,y,0) = \varphi(x,y), \quad \text{on } \Omega. \end{cases} \tag{1.1}$$

where ε is a small parameter.

This is an example of quoting an equation (1.1).

The merits of our method are as follows:

- item one
- item two

1. item one
2. item two

The outline is not required, but we show an example here.

The paper is organized as follows. Our main results are in 3, our new algorithm is in 4, experimental results are in 5, discussion is in 6 and the conclusions follow in 7.

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2. Preliminaries

2.1. This is subsection

2.1.1. *This is subsubsection*

3. Main results

We interleave text filler with some example theorems and theorem-like items.

Definition 3.1. This is a definition environment.

Lemma 3.1. *This is a lemma environment.*

Theorem 3.1. *This is a theorem environment.*

Proof. This is a proof environment. □

Lemma 3.2. *This is a lemma environment*

(i) *item A*
(ii) *item B*

$$\lim_{n\to\infty}\left(1+\frac{1}{n}\right)^n = e. \tag{3.1}$$

This is a citation example [1, 5]. This statement requires citations [3–5].
Here we state our main result as 3.2.

Theorem 3.2 (LDL^T Factorization [2])**.** *If $A \in \mathbb{R}^{n\times n}$ is symmetric and the principal submatrix $A(1:k, 1:k)$ is nonsingular for $k = 1 : n-1$, then there exists a unit lower triangular matrix L and a diagonal matrix*

$$D = \operatorname{diag}(d_1, \dots, d_n),$$

such that $A = LDL^T$. The factorization is unique.

LaTeX is a high-quality typesetting system; it includes features designed for the production of technical and scientific documentation. LaTeX is based on the idea that it is better to leave document design to document designers, and to let authors get on with writing documents.

Theorem 3.3 (Mean Value Theorem)**.** *Suppose f is a function that is continuous on the closed interval $[a, b]$ and differentiable on the open interval (a, b). Then there exists a number c such that $a < c < b$ and*

$$f'(c) = \frac{f(b) - f(a)}{b - a}.$$

In other words,

$$f(b) - f(a) = f'(c)(b - a).$$

Remark 3.1. Observe that 3.2, 3.3 correctly mix references to multiple labels.

Corollary 3.1. *Let $f(x)$ be continuous and differentiable everywhere. If $f(x)$ has at least two roots, then $f'(x)$ must have at least one root.*

Proof. Let a and b be two distinct roots of f. By 3.3, there exists a number c such that

$$f'(c) = \frac{f(b) - f(a)}{b - a} = \frac{0 - 0}{b - a} = 0.$$

□

Note that it may require two LaTeX compilations for the proof marks to show.

Display matrices can be rendered using environments from `amsmath`:

$$S = \begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix} \quad \text{and} \quad C = \begin{pmatrix} 1 & 1 & 0 \\ 1 & 1 & 0 \\ 0 & 0 & 0 \end{pmatrix}. \tag{3.2}$$

Equation 3.2 shows some example matrices.

We calculate the Fréchet derivative of F as follows:

$$\begin{aligned} F'(U,V)(H,K) &= \langle R(U,V), H\Sigma V^T + U\Sigma K^T - P(H\Sigma V^T + U\Sigma K^T)\rangle && (3.3a) \\ &= \langle R(U,V), H\Sigma V^T + U\Sigma K^T\rangle \\ &= \langle R(U,V)V\Sigma^T, H\rangle + \langle \Sigma^T U^T R(U,V), K^T\rangle. && (3.3b) \end{aligned}$$

3.3a is the first line, and 3.3b is the last line.

4. Algorithm

Our analysis leads to the algorithm in 1.

Algorithm 1 Build tree

Define $P := T := \{\{1\}, \ldots, \{d\}\}$
while $\#P > 1$ **do**
  Choose $C' \in \mathcal{C}_p(P)$ with $C' := \mathrm{argmin}_{C \in \mathcal{C}_p(P)}\, \varrho(C)$
  Find an optimal partition tree $T_{C'}$
  Update $P := (P \backslash C') \cup \{\bigcup_{t \in C'} t\}$
  Update $T := T \cup \{\bigcup_{t \in \tau} t : \tau \in T_{C'} \backslash \mathcal{L}(T_{C'})\}$
end while
return T

Adjust the width of the algorithm environment

Algorithm 2 Euclid's algorithm

procedure EUCLID(a, b) ▷ The g.c.d. of a and b
  $r \leftarrow a \bmod b$
  while $r \neq 0$ **do** ▷ We have the answer if r is 0
    $a \leftarrow b$
    $b \leftarrow r$
    $r \leftarrow a \bmod b$
  end while
  return b ▷ The gcd is b
end procedure

5. Experimental results

Some experimental results here. Some experimental results here. Some experimental results here. Some experimental results here. Some experimental results here.Some experimental results here.

Example 1. This is example environment.

Figure 5.1 shows some example results.

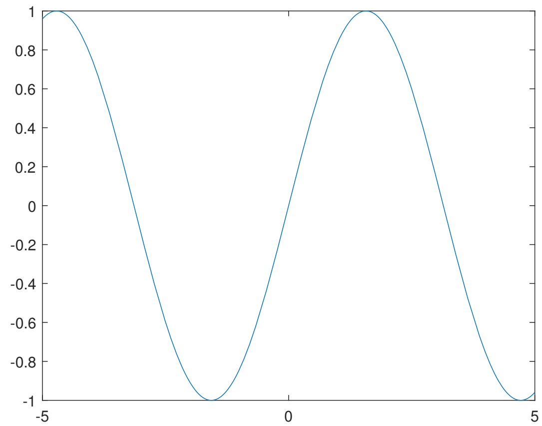


Figure 5.1. Example figure using external image files.

The two figures are placed side by side, sharing the same title, as shown in Figure 5.2.

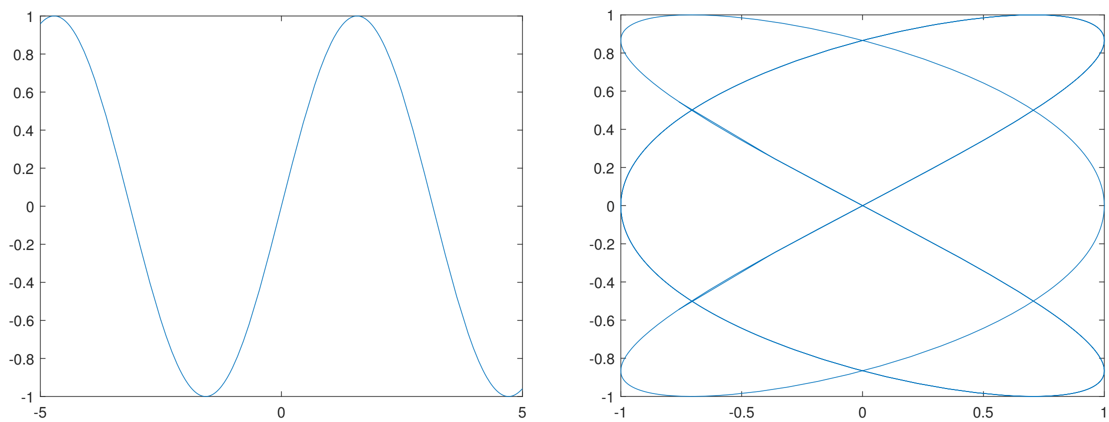


Figure 5.2. Left: Caption 1, Right: Caption 2.

Use the `tabularx` environment to generate Table 5.1. The defined column type `P` also works for `tabular` environment.

Table 5.1. Table description

N	A	B	C	D	E
2	9.20E-05	9.90E-05	1.00E-06	8.00E-06	1.50E-05
4	9.80E-05	8.00E-05	7.00E-06	1.40E-05	1.60E-05
6	4.00E-06	8.10E-05	8.80E-05	2.00E-05	2.20E-05
8	8.50E-05	8.70E-05	1.90E-05	2.10E-05	3.00E-06
10	8.60E-05	9.30E-05	2.50E-05	2.00E-06	9.00E-06
12	1.70E-05	2.40E-05	7.60E-05	8.30E-05	9.00E-05

Use `minipage` package to set images side-by-side, each with its own title, as shown in Figure 5.3 and Figure 5.4.

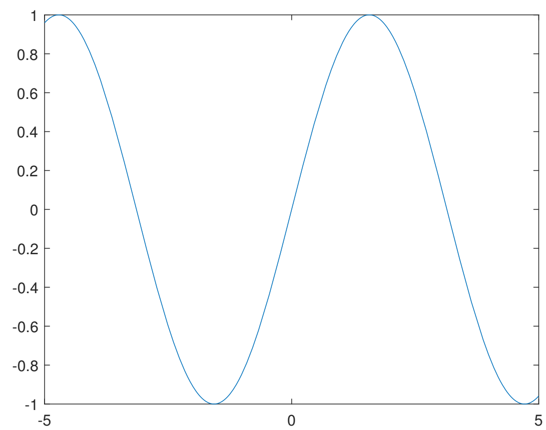


Figure 5.3. Caption A

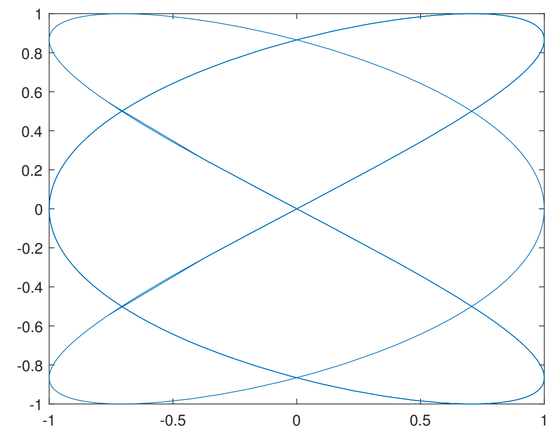
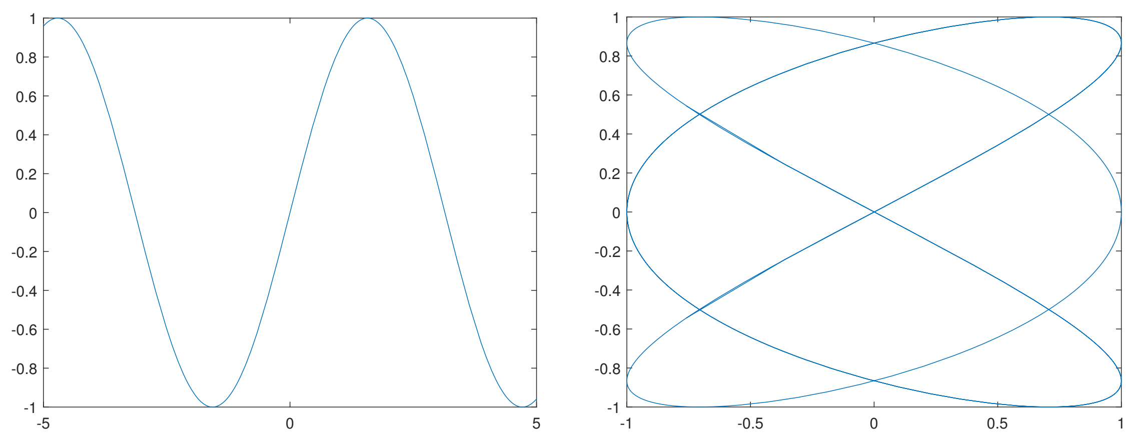


Figure 5.4. Caption B

Use `subfig` package to set subfigure, each with its subcaption, as shown in Figure 5.5.



(a) Subcaption A

(b) Subcaption B

Figure 5.5. Two subfigures

Additional results are available in the supplement in Table 5.2.

6. Discussion of $Z = X \cup Y$

Some discussions here. Some discussions here. Some discussions here. Some discussions here. Some discussions here. Some discussions here. Some discussions here. Some discussions here.

7. Conclusions

Some conclusions here. Some conclusions here. Some conclusions here. Some conclusions here. Some conclusions here. Some conclusions here. Some conclusions here.

Table 5.2. Numerical error

degree	step-size h	L^2-errors	order	H^1-errors	order	L^∞-errors	order
1	1/128	9.18E-06	2.02	7.70E-03	1.01	6.46E-07	2.02
	1/256	2.29E-06	2.01	1.92E-03	1.00	1.61E-07	2.01
	1/512	5.70E-07	2.00	9.56E-04	1.00	4.01E-08	2.00
2	1/128	1.39E-08	3.01	1.15E-05	2.01	3.48E-12	4.02
	1/256	1.73E-09	3.01	2.88E-06	2.01	3.27E-13	3.94
	1/512	2.17E-10	3.00	7.24E-06	2.00	6.66E-13	1.55
3	1/32	2.28E-09	4.05	6.92E-07	3.04	1.45E-15	8.21
	1/64	1.42E-10	4.03	8.65E-08	3.02	2.06E-14	3.85
	1/128	8.91E-12	4.01	1.08E-08	3.01	3.86E-14	0.91

A. An example appendix

The contents of the appendix are here.

Lemma A.1. *Test Lemma.*

This is a equation in appendix.

$$a^2 + b^2 = c^2. \tag{A.1}$$

Acknowledgments

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References

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