

# How to write and publish a math paper?

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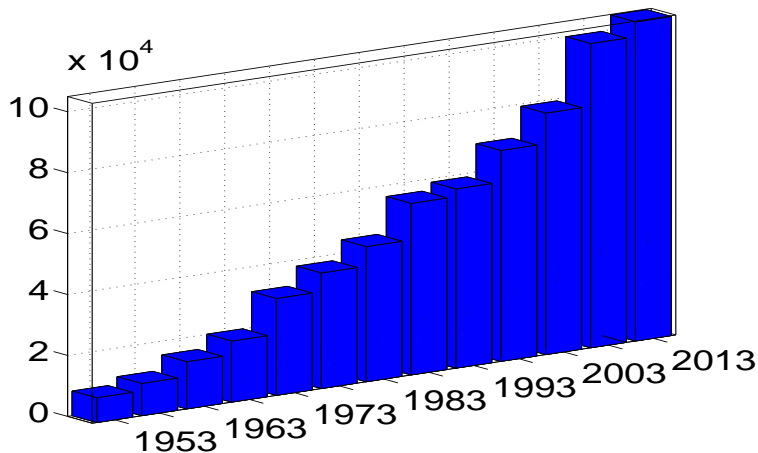
# Literature

- Website of Terence Tao  
<http://terrytao.wordpress.com/advice-on-writing-papers>
- Paul Halmos: How to write mathematics  
<http://www.math.uga.edu/~azoff/courses/halmos.pdf>
- Steven Krantz: How to write your first paper  
<http://www.ams.org/notices/200711/tx071101507p.pdf>
- Ashley Reiter: Writing a research paper in mathematics  
<http://web.mit.edu/jrickert/www/mathadvice.html>
- N.J. Higham: Handbook of Writing for the Mathematical Sciences. SIAM, 1998
- T. Skern: Writing Scientific English. Facultas, 2009
- Just google “How to write a math paper” ...

## Why should you bother?

- Share your ideas to others.
- Communicate your math results to non-experts.
- Writing is an art.
- Learn to write well theoretical or numerical papers.
- Learn to tell a story.

## Why should you bother?



Number of math articles, theses etc. per year (source: MathSciNet)

*How is reading all these papers? Thus: Write well to catch attention!*

# Concept of a math paper

**Assumption:** You have achieved significant and new results (theorems, numerics etc.) and want to publish them in a scientific math journal.

**General structure:**

- Title
- Acknowledgements
- List of authors
- Abstract
- Introduction
- Body of the work
- Appendix, conclusions (optional)
- References

# Title and Acknowledgement

## Title:

- Use few well-chosen (key) words, not too general.
- No abbreviations, avoid symbols.
  - ✗ On a nonlinear parabolic problem from physics
  - ✗ The conjecture of Budd-Smith-Watson in unframed HBK geometry
  - ✓ Numerical stability of mixed finite-element methods for viscoelastic flows

## Acknowledgement:

- Thank people for support or help.
- Do not forget to thank foundations for financial support.
  - ✓ The authors thank XYZ for fruitful discussions.
  - ✓ The authors thank XYZ for her/his hint on the paper ABC.
  - ✓ The authors acknowledge partial support by the Austrian Science Fund (FWF), grant W1245.

## List of authors

- In math, often alphabetically (even if work unequally distributed).
- If one author did much more than the authors, put her/him first.
- In physics or engineering, order to authors counts.



# Abstract

- Abstract and introduction are your main “selling points” .
- Should be short and concise; put the essence in a nutshell.
- Attract interest in your work .
- Avoid empty phrases.
  - ✗ In this paper, among other things, we prove that ...
  - ✓ We prove that ...
- Avoid symbols and formulas, use nontechnical language if possible.

## Example:

- First sentence: **What** is shown/presented?
- Second sentence: **Why** is the studied problem of interest? Or what is the key issue?
- Third sentence: **How** your (theoretical, numerical) results have been obtained? Key ideas, novelty?

## Abstract: real-world examples

### Example 1:

The existence of local continuous weak solution to a degenerate fourth-order parabolic equation is proved. The model is a Fokker-Planck approximation of the Boltzmann-Nordheim equation, describing condensation phenomena related to Bose-Einstein particles. The proof is based on approximation arguments, interpolation inequalities in weighted Sobolev spaces, and entropy-type estimates.

### Examples 2:

We present and analyze a coupled finite element-boundary element method for a model in stationary micromagnetics. The finite element part is based on mixed conforming elements. For two- and three-dimensional settings, we show well-posedness of the discrete problem and present an a priori error analysis for the case of lowest order elements.

## Abstract: real-world examples

### Example 3:

We act on the assumption that the boundary of every 'physical' domain  $\Omega$  has microscopic asperities which influence the boundary behaviour of weak solutions of the Boussinesq equations. Let  $\Omega_n \subseteq \mathbb{R}^3$ ,  $n \in \mathbb{N}$ , be domains with rough boundaries and let  $\Omega_n$  'converge to'  $\Omega$ . Consider a sequence  $(u_n, \theta_n)_{n \in \mathbb{N}}$  of weak solutions of the Boussinesq equations with  $u_n$  fulfilling the impermeability condition  $u_n \cdot N = 0$  on  $\partial\Omega_n$  and  $\theta_n$  fulfilling the Robin boundary condition  $\frac{\partial\theta_n}{\partial N} + \alpha(\theta_n - h_0) = 0$  on  $\partial\Omega_n$ . In this paper the boundary conditions and limit equations of weak limits of  $(u_n, \theta_n)$  on  $\Omega$  under certain assumptions on the rugosity of the boundaries will be determined.

- ✗ Even the first sentence is not understandable for non-experts.
- ✗ Too many formulas, can be expressed in words.
- ✗ What is the novelty?

# Abstract

Source: [www.phdcomics.com](http://www.phdcomics.com)



# Introduction

## General:

- Again: Interest your reader in the first paragraph.
- Zoom in from the big picture towards your specific results.
- Come to the point: Readers want to know as soon as possible if they are interested in reading your paper or not.
- Do not plagiarize (copy & paste).

## Structure:

- States the context and the problem.
- Key difficulties, what is new?
- Statement of main results/theorems (maybe in a special case).
- Your main ideas (of the proof, discretization, implementation).
- State of the art, related work.
- Concluding remarks: generalizations, limitations, future work.
- Outline the logical structure of the paper.

# Introduction

B. Ali, M. Minjibir: *Quasi- $\phi$ -asymptotically nonexpansive mappings*

**Introduction:** Let  $E$  be a Banach space and  $E^*$  de the dual space of  $E$ . The normalized duality mapping  $J : E \rightarrow 2^{E^*}$  is defined by

$$Jx = \{x^* \in E^* : \langle x, x^* \rangle = \|x\| \|x^*\|, \|x^*\| = \|x\|\} \quad \forall x \in E,$$

where  $\langle \cdot, \cdot \rangle$  denotes the normalized duality pairing. A Banach space  $E$  is said to be uniformly convex if given  $(0, 2]$ , there exists  $\delta > 0$  such that  $\forall x, y \in E$  with  $\|x\| \leq 1$ ,  $\|y\| \leq 1$  and  $\|x - y\| \geq \varepsilon$ , we have  $\|\frac{x+y}{2}\| \leq 1 - \delta$ .  $E$  is strictly convex if  $\|\frac{x+y}{2}\| < 1$  for all  $x, y \in E$  with  $\|x\| = \|y\| = 1$  and  $x \neq y$ . The space  $E$  is said to be smooth if the limit

$$\lim_{t \rightarrow 0} \frac{\|x + ty\| - \|y\|}{t}$$

exists for all  $x, y \in U$  where  $U = \{z \in E : \|z\| = 1\}$ . It is also uniformly smooth if the limit exists uniformly for  $x, y \in U$ . It is well known that if  $E$  is strictly convex, smooth and reflexive, then the duality map  $J$  is one-to-one, single-valued and onto. Also if  $E$  is uniformly smooth, then  $J$  is norm-to-norm uniformly continuous on bounded subsets of  $E$ . **Do you want to continue to read?**

# Introduction

A. Constantin, K. Kalimeris, O. Scherzer: *A penalization method for calculating the flow beneath travelling water waves of large amplitude*

**Introduction:** Water flows with a uniform underlying current (possibly absent) are termed irrotational flows, while rotational waves describe the interaction of surface water waves with non-uniform currents. The study of the flow beneath an irrotational two-dimensional surface wave in water with a flat bed is quite well-understood: see [3, 7] for theoretical studies, [2, 12] for numerical simulations and [1, 14] for experimental data. (...) These flows represent significant examples of rotational waves and our purpose is to pursue their in-depth study. We present a penalization method that selects from the family of solutions to a reformulation of the governing equations genuine waves. This permits us to provide accurate simulations of the surface water wave but also of the main flow characteristics (fluid velocity components, pressure) beneath it.

## A word on notation

- Use notation to clarify not to confuse. Follow standard notation.
  - ✗ Let  $D_{x,y,*}^{(i,j)}(a,b)$  be the set of all ...
- Recall definitions and notation if suitable.
- Do not mix notation, be consistent.
  - ✗ For all  $\varepsilon > 0$ ,  $\exists \delta > 0$  such that ...
- Be unambiguous.
  - ✗  $f^2(x)$  can mean either  $f(x)f(x)$  or  $f(f(x))$ .



# A word on English language

- Use correct English.
  - ✗ The goal of this paper is devoted to justify ...
- Do not copy & paste complete sentences or paragraphs from other papers.
- Be verbose to be clear but concise to point to the key issue.
- Use a spell-checker but do not rely on it: Revise your draft again and again.
- Write full sentences; equations must be part of complete sentences.
  - ✗ Let  $x > 0$ . Where  $x$  satisfies  $x \in D$ .
- Avoid abbreviations.
  - ✗ WLOG, assume that  $\varepsilon > 0$ .
  - ✗ There is a point s.t.  $f(x) > 0$ .

## Body of the work

- Structure your paper in several sections.
- Should contain full proofs, details of numerical implementation etc.
- Split a lengthy proof in several steps or several lemmas.
- Take care of the logical flow.
- Try to simplify proofs or the presentation.

**Example:** By (2.12), (3.14), (4.2), (4.4), (5.1), and (5.18), Young's and Hölder's inequality as well as the Sobolev embedding theorem, we obtain

$$\int_{\Omega} |\nabla u|^2 dx \leq \frac{1}{2} \int_{\Omega} (f(x)^2 + u^2) dx.$$

- ✗ You need to scroll the whole paper to check all the formulas.
- ✗ Too compressed, split into smaller steps while still being concise.

## Body of the work: Another example



## Body of the work: Examples of structure

- 1 Introduction
- 2 Proof of Theorem 1
- 3 Proof of Theorem 2
- 4 Proof of Theorem 3
- 5 Extensions

- 1 Introduction
- 2 Numerical scheme and main results
- 3 Existence of a discrete solution
- 4 Numerical convergence
- 5 Numerical examples

# How to write a proof?

- Provide all logical steps but do not explain obvious arguments.
  - ✗ By adding and subtracting  $b$ , it follows that  $a = (a - b) + b$ .
- Justify each step, give clear arguments.
  - ✗ It is easy to see that ...
  - ✓ By using the invariance principle, we find that ...
- Break the proof up in smaller pieces (steps, lemmas, subsections).
- At the end of a long argument, summarize it.
- Mark the end of the proof.

# Optional elements

## Conclusion:

- Some journals require a concluding section.
- Do not just repeat the introduction.
- Add consequences, future work.

## Appendix:

- Technical proofs which do not clarify an idea may be put in an appendix.
- May contain less known but published results needed in the paper.
  - ✓ Appendix: Orlicz spaces
  - ✗ Appendix: Sobolev embedding theorems [except if non-standard]
- May contain details of numerical implementation.

# References

## Generalities:

- Main idea: Justify all arguments by a proof or a reference.
- List all references at the end of the paper.
- List a paper when it is cited in the text.
- Do not cite standard results.
  - ✗ Text: By the Young inequality [1], ...  
Reference: [1] O. Forster. Analysis. Vieweg+Teubner, 2004.
- Do you have cited the most important papers? (Reviewers may be angry if they are not cited!) But do not overdo.
- For non-published papers, provide a link, e.g. from [www.arXiv.org](http://www.arXiv.org).
- Avoid citations like “A. Friend. Private communication, 2014.”
- Self-citations do not help much...

# References

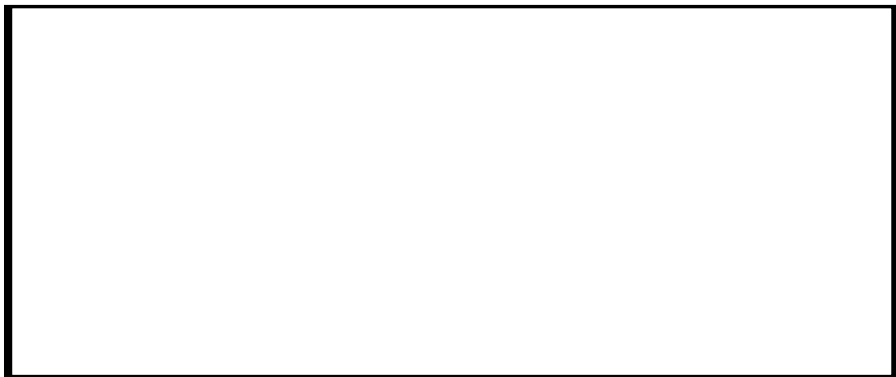
## Technicalities:

- Provide full titles.
- Abbreviations for journals: check [www.ams.org/mathscinet](http://www.ams.org/mathscinet).
- Be careful with correct citation of contributions to proceedings; check MathSciNet.
- Check the journal style: italicize names of journals?
- **Numbers:** [1] A. Müller and B. Smith. An easy proof. *J. Appl. Math.* 23 (2014), 1-10.  
Citation: As shown in [1], there exists ...
- **Abbreviations:** [MS14] A. Müller and B. Smith. An easy proof. *J. Appl. Math.* 23:1-10, 2014.  
Citation: As shown in [MS14], there exists ...
- **Names:** A. Müller and B. Smith (2014). An easy proof. *J. Appl. Math.* 23, pp. 1-10.  
Citation: As shown in Müller & Smith (2014), there exists ...



## Concluding remarks

- Recall: Tell a story of interest!
- Writing math texts is an art (not a religion – see below...)!
- Finished your paper? Read it again. And again. And again. And then stop.



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  - Preprint archive
  - Choice of the journal, submission
  - Decision
  - Publication

## General procedure

- Publish your paper in a preprint archive.
- Choice of a journal.
- Submit the paper.
- Wait for the answer.
- Receive the reports (3-12 months).
- Revise the paper and send again.
- Wait for final acceptance.
- Send tex files and wait for the galley proofs.
- Correct the galley proofs.
- Wait for the publication (3-12 months).

*The whole procedure may take 1-3 years!*

# Preprint archive

- As a service to the community, publish your paper online: your website, DK preprint archive, preprint archive of the department, other preprint archives.
- Some preprint archives: [www.arXiv.org](http://www.arXiv.org) (international), [hal.archives-ouvertes.fr](http://hal.archives-ouvertes.fr) (France).
- Do not put published papers in these archives (copyright, see below)!
  - ✓ Fast communication of new results (journal publishing takes usually 1-3 years).
  - ✓ Excellent collection of recent works.
  - ✓ Free of charge.
  - ✗ No reviewing process, (almost) no quality control.
  - ✗ Be careful of publication restrictions when cooperating with companies.

# Choice of the journal

Choosing the right journal is of critical importance: match topic and level.

## Audience:

- Check journal homepages for the scope of the journal: theoretical results, results related to applications, numerical analysis, numerical simulations, engineering applications?
- Which audience: mathematical, physical, biological, or engineering?
- Specialized or general-interest journal?
- Do you know somebody from the editorial board?

## Level:

- Ranking of math journals: *Journal Citation Report of Web of Science*, according to the impact factor.
- Impact factor = average number of citations received per paper published in a journal during the last preceding years.
- Do not over-interpret the impact factor. It may vary largely from year to year.

# Ranking of journals: Applied Mathematics 2010



## A word on publication time frame

- The reviewing process and the publication process (from acceptance to printing) may be very long (1-3 years).
- Ask colleagues for the journal's average time between submission and acceptance/publication.
- Some foundations consider accepted papers to be as good as published papers (printed in a journal).
- For postdoc applications, the number of accepted papers may count (but no preprints). So, be careful in choosing the journal.

## Submission process

- Some journals require the preparation of the manuscript using the style files of the journal.
- Submit your manuscript; usually, this is done via a web interface.
- Submit a paper to only one journal at a time!
- You should obtain within 1-3 days an acknowledgement of receipt.
- The **editor-in-chief** makes a quality check and either sends the manuscript back or sends it to an editor whose field is close to the topic of the paper. Immediate rejection: takes only a few weeks.
- The **editor** makes a quality check and either sends the manuscript back or sends it to 1-3 referees who evaluate your manuscript.
- Depending on the journal, you will receive the **referee reports** after 3-12 months. Do not inquire too early, but after 9 months you may remind the editorial office. Thus, keep good records.
- Keep in mind that the work of the editors and referees is honorary.



## Decision process

Based on the reports, the editor makes a recommendation: **acceptance**, **minor revision**, **major revision**, **rejection**. The decision is made by the editor-in-chief and sent to the contributing author by e-mail.

- **Rejection:** The reports may be unfair, but there is no hope to argue. Read the reports carefully and revise your paper. If the referee misunderstood, explain better your ideas.
- **Major revision:** The referees may ask you to restructure the paper, to correct a mistake in the proof, to modify/add your numerical experiments. Just do it. Argue only if fully justified.
- **Minor revision:** The referees may ask you to correct some typos or small inconsistencies or to add references.
- After the revision, answer all concerns of the referees in a letter. Explain what you modified or corrected.
- **Acceptance:** Congratulations, your paper will be published!

## How to address the reviewer comments?

- Take each comment seriously. Answer all questions.
- If the reviewer is wrong, explain carefully your point.
- Maybe use **red color** to highlight the changes in the paper.

# Publishing process

After acceptance, you will be asked to submit the **tex files**, to sign the **copyright agreement**, and possibly to fill out some **order form** (reprints, colored figures, open access).

## Tex files:

- Use the style file of the journal.
- Some journals have requirements on the list of references (ordered by appearance, alphabetically, physics: without titles).
- Add keywords and *Mathematics Subject Classification 2010* subject numbers.
- Do not forget the acknowledgement: *The authors acknowledge partial support from the Austrian Science Fund (FWF), grant W1245.*

## Copyright agreement:

- The authors hold the copyright and need to transfer it to the journal.
- Take care to keep the right to publish the preprint (not the manuscript in the journal's style) in a public preprint archive.

# Publishing process

## Order form:

- Usually, you will receive a free pdf reprint. You may pay for additional printed reprints. Do not publish the free pdf reprint online!
- The online version of your paper may be in color, the print version is always black & white. If you wish to publish colored figures in the print version, you need to pay (not reimbursed by the DK).
- If you pay the Open Access charge, your paper will be freely accessible on the journal's homepage.
- The FWF supports Open Access, but there is also criticism (charges are too high, publisher's policies are too restrictive).

## Concluding remarks

- Writing and publishing academic papers is not an easy task but do not discourage!
- If your paper is rejected, do not lose heart. Sometimes it's fair (wrong journal, mistake in the proof), sometimes it's not.
- Developing own ideas and sharing it with others, is one of the most rewarding part of academic life.
- Publishing, discussing, presenting often leads to new insights and new collaborations. Take advantage of this process.
- Good luck for your first, second,  $n$ -th paper!

