

How to write great papers and get published



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Agenda

- Introduction to Scientific Publishing
- How is a journal organized?
- The editorial process and the peer review
- Developing a manuscript
- Submitting a manuscript
- Publishing ethics
- Promoting your paper

Origin of Scientific Publishing



- 1665: Publication of first scientific journal “*Philosophical Transactions of the Royal Society*”
- The society's council minutes dated 1 March 1664 ordered that “*the Philosophical Transactions, to be composed by Mr Oldenburg, be printed the first Monday of every month, if he have sufficient matter for it.*”
- Private venture of the Royal Society's secretary, Henry Oldenburg
- Still exist (as Part A and Part B)

Origin of Scientific Publishing

“*Philosophical Transactions of the Royal Society*” already contained three key elements of a journal:

- Registration and archiving:

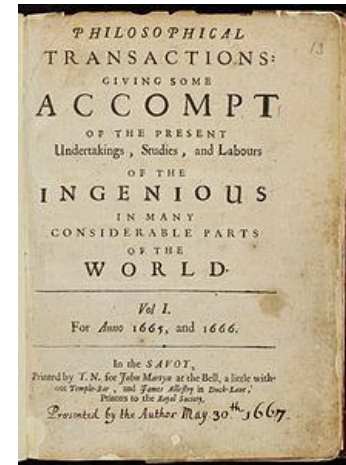
“We must be very careful as well of registering the person and time of any new matter, as the matter itself, whereby the honor of the invention will be reliably preserved to all posterity”

- Dissemination

“...all ingenious men will thereby be encouraged to impact their knowledge and discoveries”

- Peer review

“ ...being first revised by some Members of the Council of this Society ”



Scientific Publishing nowadays

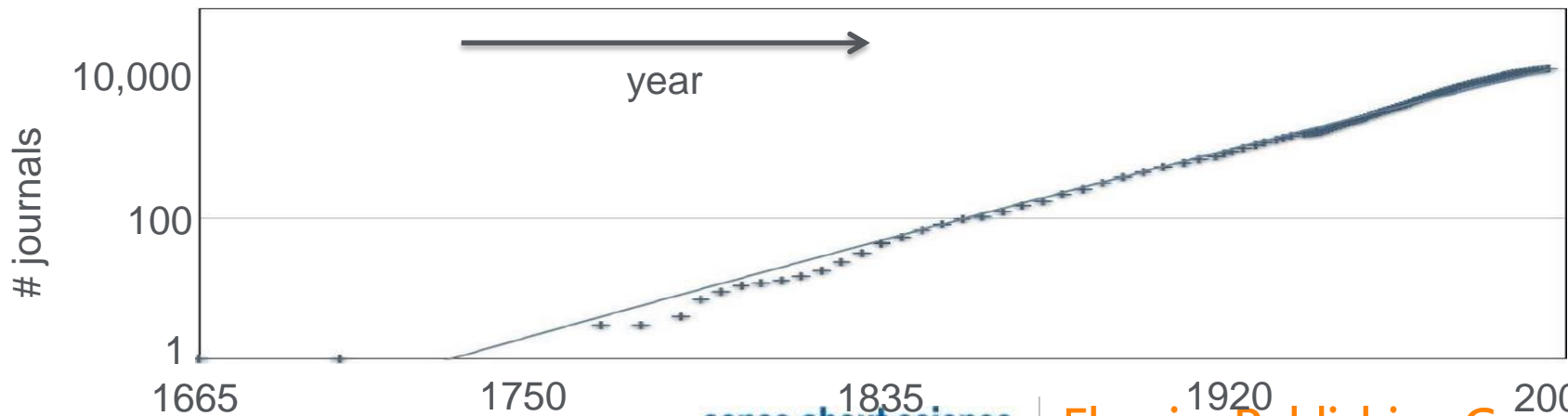
- ~5,500 scientific journal publishers
- ~35,000 peer-reviewed scholarly journals
- ~2,600,000 published articles per year
(this rate increases ~3% per year)
- ~4,000,000 unique authors in a year
(this number increases with ~3% per year)

The top four largest publishers:

1. Elsevier
2. Springer-Nature
3. Wiley
4. Taylor & Francis



Together they publish 40% of all journals



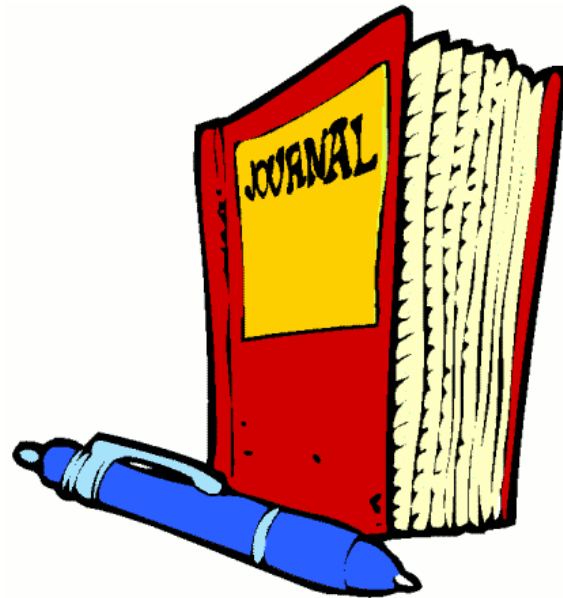
How is a journal organized?

How is a journal organized?

- People
 - Editor
 - Editorial/advisory board
 - Publisher

- Aims and scope

- Quality



Journal organization: People

- What are the responsibilities of an editor?
 - Responsible for scientific quality
 - Checks papers and decides which papers get published
 - Coordinates the peer-review process
 - Communicates with authors and reviewers
 - Defines aim & scope of journal (with publisher)
 - Advises on strategy and direction of journal
 - Usually professor at esteemed university
 - Often a team of editors



Journal organization: People

- What is the role of an Editorial Board or Advisory Board?
 - Members are ...
 - ...appointed by publisher and editors
 - ...experts in a subfield of the journal
 - ...can be consulted when needed
 - ...sometimes involved in review process
 - The Board
 - ... advises on topics for special issues and review papers
 - ... advises on strategy and future direction of journal
 - ... represent authors and readers of the journal



Journal organization: People

- What are the responsibilities of a publisher?
 - Organization:
 - Overall management of journal
 - Providing the editorial infrastructure (peer-review process)
 - Arranging the publication of accepted manuscripts
 - Distribution and promotion of journal to readers/libraries
 - Tagging and archiving of all published articles
 - Dealing with ethical and copyright issues
 - Appointing editors and editorial board



Journal organization: Aims & Scope

- A journal always has an Aims & Scope, a text that describes the goal of the journal:
 - Subject
 - Audience
 - Type of articles
 - Quality or coverage of field
 - Association with group



Journal organization: Aims & Scope

Tetrahedron publishes experimental and theoretical research results of outstanding significance and timeliness in the field of organic chemistry and its application to related disciplines especially bio-organic chemistry.

Areas covered by the journal include the many facets of organic synthesis, organic reactions, natural products chemistry, studies of reaction mechanism and various aspects of spectroscopy.

Contributions take the form of full papers, which are major original contributions to the literature.

Tetrahedron also publishes specially commissioned review articles - *Tetrahedron Reports* - and collections of original papers - *Tetrahedron Symposia-in-Print*.

Journal organization: Quality

- Several indicators exist that aim to measure quality.
- The indicators assume that the importance of a paper can be assessed by number of citations.
- The most popular indicator, the Impact Factor, has a 'citation window' of two years.
- CiteScore recently launched alternative
- Impact Factor/CiteScore also dependent on discipline, type of articles and scope of journal

Journal organization: Impact Factor

- Impact Factor (IF): average number of times articles from a journal published in the past two years have been cited in the current year

$$\frac{\text{All citations in 2014 to articles published in 2012 and 2013}}{\text{All articles published in 2012 and 2013}} = 3.456$$

1339 + 1467 = 2806

350 + 462 = 812

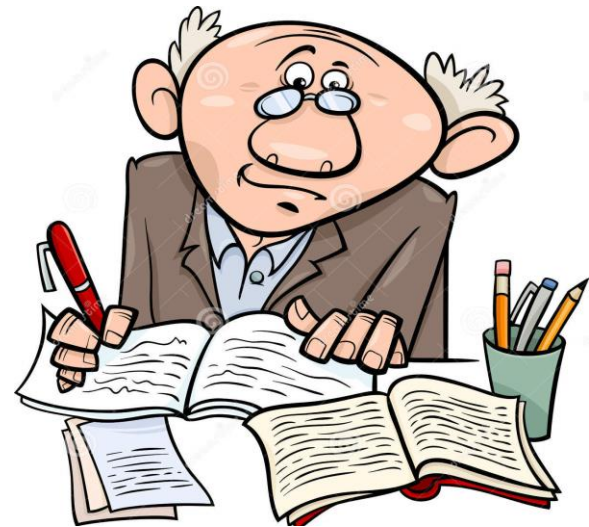
Journal organization: CiteScore

- New quality indicator launched 2017.
- Three year citation window
- CiteScore's numerator and denominator both include all document types
- Current: develops on monthly basis

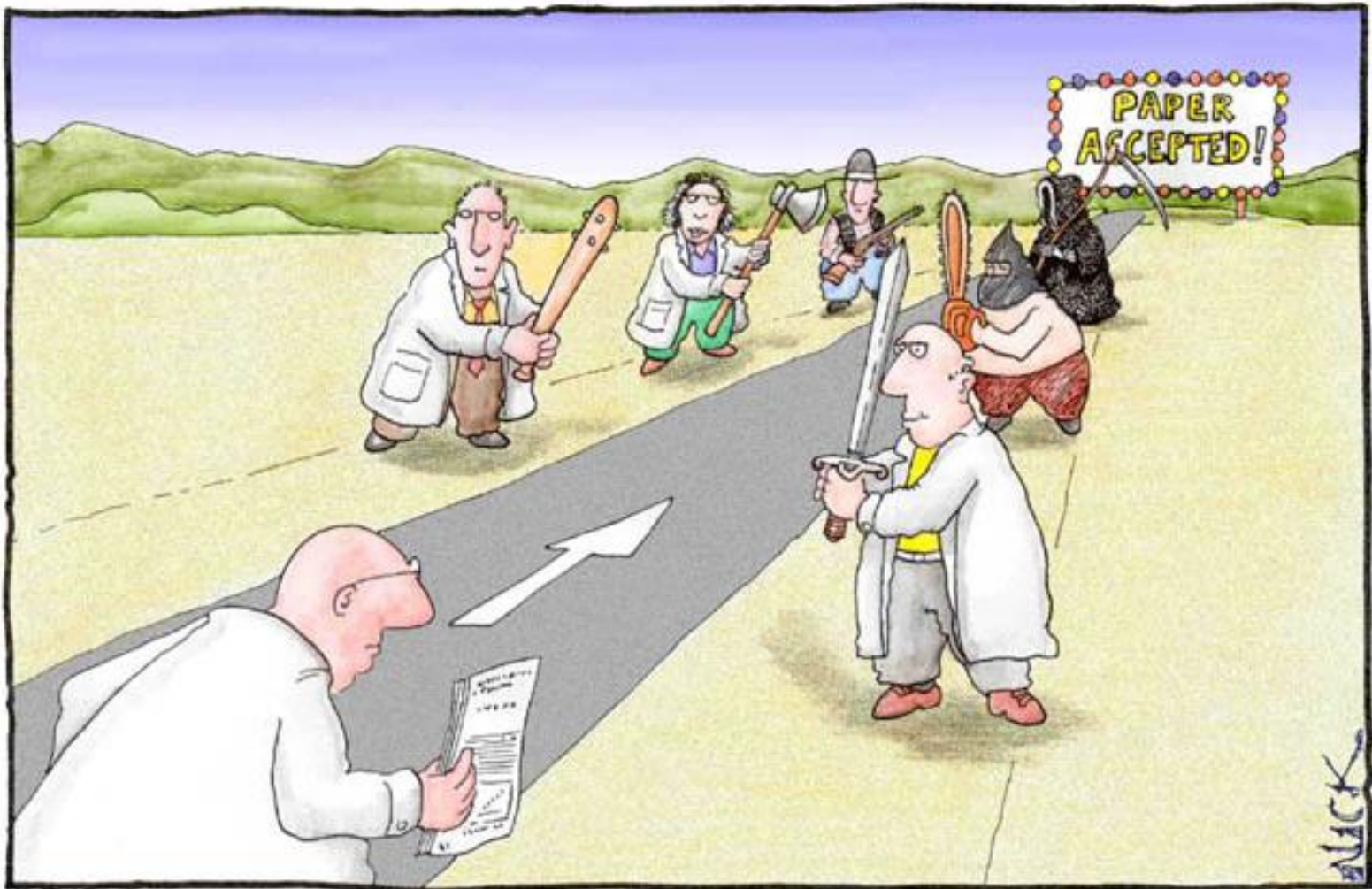
Editorial process

Editorial process

- The editorial process selects suitable articles for publication and publishes papers in one standard format.
- The key step is the peer-review process



The peer-review process



Peer-review process

- Essential filter to separate science from speculation and to determine scientific quality
- Publishers have ensured the sustainability of journals and the peer-review system for over 300 years. They stand outside the academic process and are not prone to prejudice or favor.
- Helps to determine the validity, significance and originality of research
- Helps to improve the quality of papers
- Protects the author's work and claim to authorship

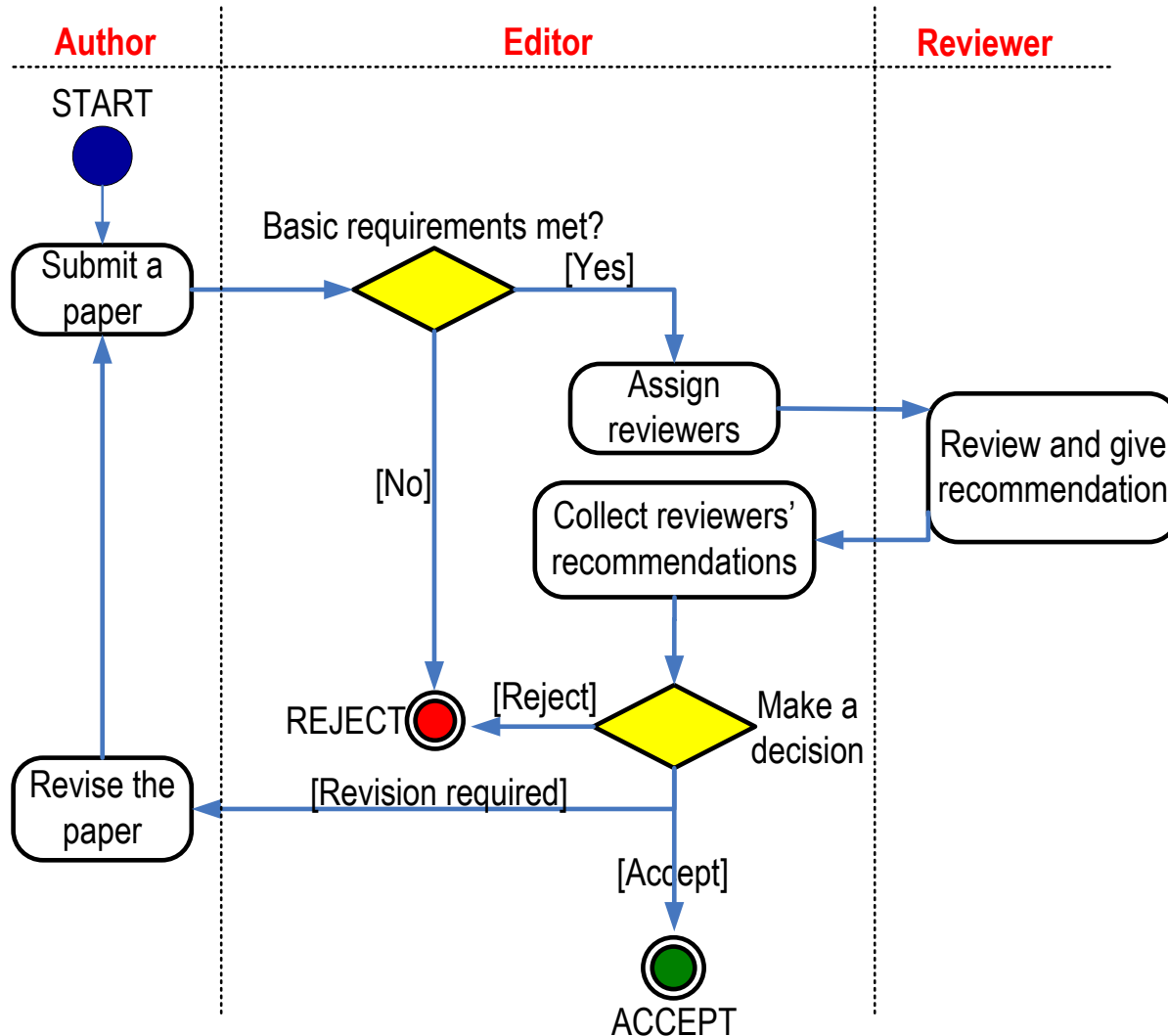


Peer-review process

- Generally editors do a first check (topic, language, completeness,...). They are allowed to desk-reject.
- After initial check, they will send out for review, usually to a few referees. Review process takes several weeks. Many invited reviewers decline invitation, adding to review times.
- Editor receives referee-reports and takes a decision based on them.
- In case of doubt, they may consult another referee or review themselves.
- Editor informs author



Peer-review process



Editor's decision

- Accept.
- Reject
- Accepted after minor/major revisions

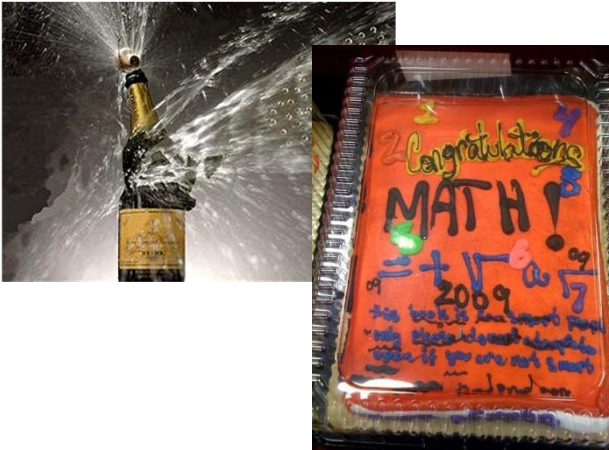




First Decision: “Accepted” or “Rejected”

Accepted

- Very rare, but it happens



- Congratulations!
- Cake for the department
- Now wait for page proofs and then for your article to be online and in print

Rejected

- Probability 40-90% ...
- Do not despair
 - It happens to everybody
- Try to understand WHY
 - Consider reviewers' advice
 - Be self-critical
- If you submit to another journal, begin as if it were a new manuscript
 - Take advantage of the reviewers' comments and revise accordingly
 - They may review your manuscript for the next journal too!
 - Read the Guide for Authors of the new journal, again and again.



Revisions: address all comments from reviewers

- The editor may decide that your paper can be published, but only after you have revised your manuscript.
- Carefully **study the reviewers' comments**, adjust your manuscript and prepare a detailed letter of response
- **Respond to all points**; even if you disagree with a reviewer. Provide a scientifically solid rebuttal, not ignore their comment
- State specifically what changes you have made to address the reviewers' comments, mention page and line numbers where changes have been made
- Perform additional experiments, calculations or computations, if required; these usually serve to make the final paper stronger



Rejected or accepted?

- When papers are rejected, the author may submit to another journal. However, it is advisable to improve the manuscripts following comments from editor/reviewers.
- When papers are accepted, but revisions are required, improve manuscript according to comments editor/reviewers..
- After acceptance, manuscripts is typeset according to journal requirements.
- Manuscripts is available online >> uncorrected proofs >> corrected proofs
- Proofs are returned to author and editor for corrections. After corrections, paper is fully published and fully citable.

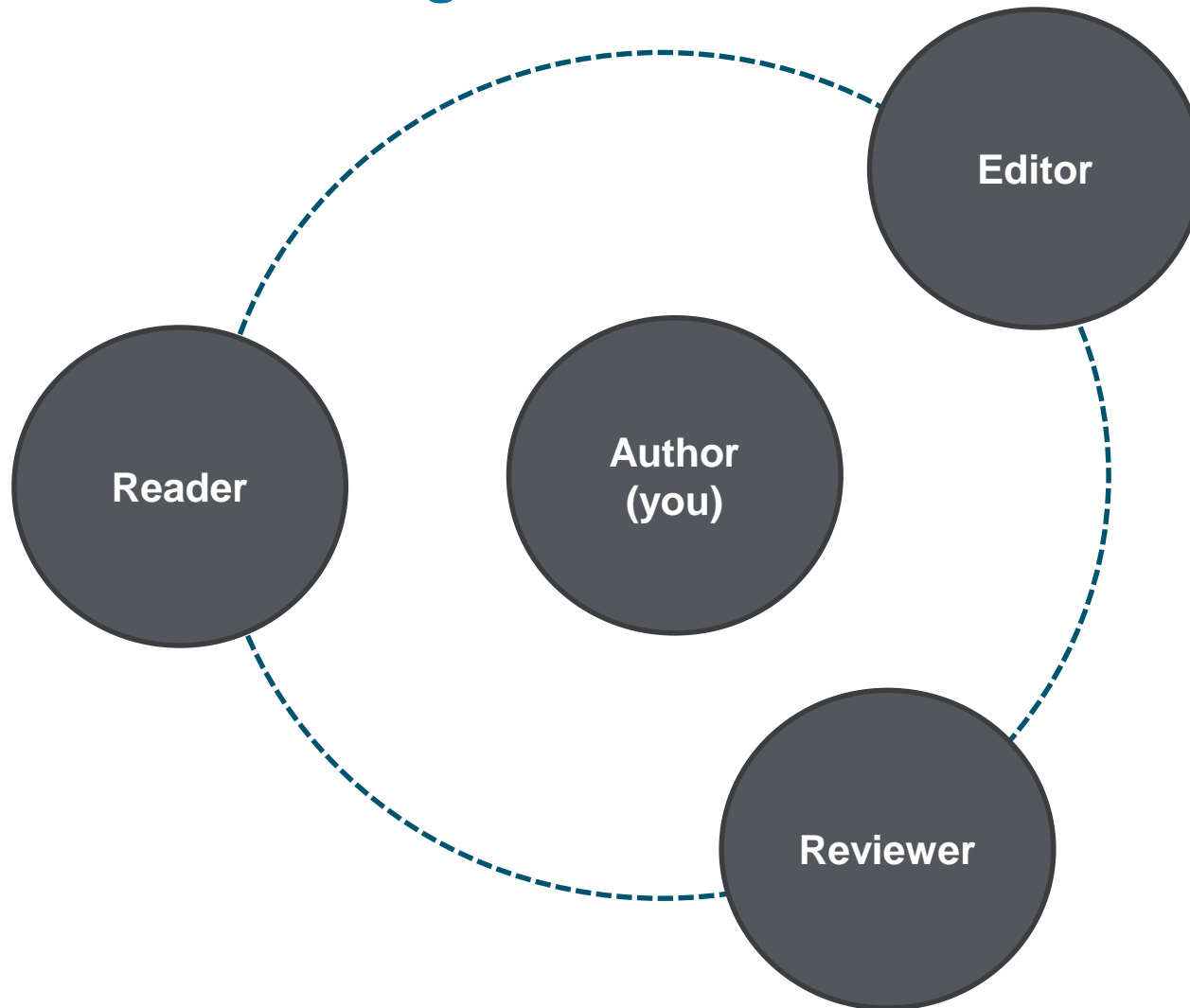
Developing a manuscript

Developing a manuscript

Based on many discussions with handling editors!

1. Think before writing
2. Choose the right journal and article type
3. Use the right process to write paper
4. Language
5. Ensure paper is up-to-date and in right context
6. Use the correct article structure
7. Be prepared for common questions of reviewers

1. Think before writing



1. Think before writing

- Do not just think as an author, about what you want to report. Also think as a reader: how will your paper be clear, logical and easy to read.

- What is the main message to the reader
 - Write down the central message of your research
 - Summarize your research in one or two sentences
 - What is the novelty of your work?
 - Pitch your research in one minute to someone else

1. Think before writing

What do editors want?

- Remember: you want to get published, but editors want **original and attractive papers for their journal**. So, focus on what the reader wants to read

- All editors and reviewers hate wasting time on poorly prepared manuscripts and will reject

- Editors want:
 - Originality
 - Significant advances in field
 - Clear context and relations to previous work
 - Appropriate methods and conclusions
 - Readability
 - Studies that meet ethical standards



1. Think before writing

Follow the guide for authors!

- All journals have a detailed guide-for-authors which contains precise instructions how to prepare a manuscript
- Read carefully and follow the instructions
- Pay attention to
 - Layout and section lengths (stick to word limits)
 - Nomenclature, abbreviations and spelling
 - Reference format
 - Number/type of figures and tables
 - Statistics
 - Guidelines to submission



2. Choose the right journal and article type

- Select the right journal by considering:
 - Aims & Scope (check journal websites and recent articles)
 - Types of articles (full paper, letter, review paper)
 - Audience (specialists, multidisciplinary, general)
 - Recently published papers



2. Choose the right journal and article type

- The right article type:
 - Full Articles/Original Article
 - Reporting complete and thoroughly analyzed research
 - Short Communications/Notes/Letters
 - Quick and early communications of significant, original advances
 - Conference Papers
 - Paper based on presentation at conference
 - Review Papers/Perspectives
 - Usually by invitation only



2. Choose the right journal and article type

- Tool: journalfinder.elsevier.com
- Simply insert your title and abstract and select the appropriate field-of-research for the best results.
- Suggests suitable journals and provides information on editorial times, acceptance rate, production speed, open access options,...




Search results (10)

Journal title **Sort by Match** ▼ Impact Factor CiteScore Open access Review speed Acceptance Production speed


The Lancet Infectious Diseases

[More metrics details](#) [Scope and information](#) ▼

	25.148	6.81	5 weeks	23 %	10 weeks	Optional	-	\$ 5,000	More info ↗	Submit paper
Match	Impact	CiteScore	Review speed	Acceptance	Production speed	Open access	Embargo period	OA Fee + License		


Journal of Clinical Virology

[More metrics details](#) [Scope and information](#) ▼

	3.101	2.79	7 weeks	28 %	1 weeks	Optional	12 Months	\$ 3,150	More info ↗	Submit paper
Match	Impact	CiteScore	Review speed	Acceptance	Production speed	Open access	Embargo period	OA Fee + License		


Vaccine

[More metrics details](#) [Scope and information](#) ▼

	3.285	3.19	7 weeks	51 %	3 weeks	Optional	12 Months	\$ 2,450	More info ↗	Submit paper
Match	Impact	CiteScore	Review speed	Acceptance	Production speed	Open access	Embargo period	OA Fee + License		

International Journal of Infectious Diseases

[More metrics details](#) [Scope and information](#) ▼

	3.202	2.8	3 weeks	26 %	2 weeks	Yes	-	\$ 1,750	More info ↗	Submit paper
Match	Impact	CiteScore	Review speed	Acceptance	Production speed	Open access	Embargo period	OA Fee + License		

3. Use the right process to write paper

Process:

- 1) Collect elements of paper
- 2) Prepare a first draft
- 3) Rewrite/improve



The process of writing – building the article



3. Use the right process to write paper

1) Collect elements of paper

- Prepare an outline to start writing a first draft:
 - Determine the central message, the research questions
 - Prepare draft versions of plots, figures, tables, images
 - Summarize main findings and group in a logical way
 - Select references



3. Use the right process to write paper

2) Write the first draft

- Write a first draft with outline, figures and tables as your guides
 - Write in your own style, quickly and without editing
 - Do not care about language quality

- Read your first draft and add notes
 - Read it as a critical reader (not as the author)
 - Is the main message clear to new readers?



3. Use the right process to write paper

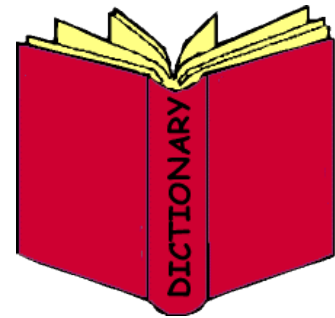
3) Rewrite and improve

- Revise the text
- Improve the order and logic of the scientific content
- Identify gaps and improve unclear parts
- Remove double/redundant text
- Optimize the readability (clear, concise, short sentences)
- Correct language errors
- Is the text consistent and coherent? (important when multiple authors write the text)
- Get feedback from co-workers and colleagues



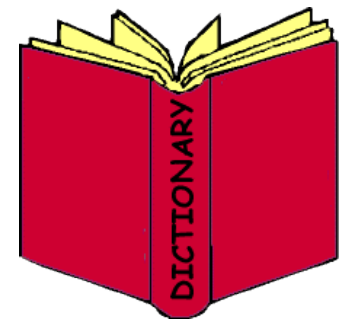
4. Language

- Journal editors and in particular reviewers may reject a manuscript simply because of frequent language mistakes. In any case they will be irritated.
- Publishers do not language edit manuscripts
- If English is not your mother-tongue:
 - Find a native-English speaker to read and correct your manuscript
 - Use a paid-for editing service. More information at <http://webshop.elsevier.com/languageediting/>
- DO NOT copy complete phrases from other papers, it may be considered plagiarism!
- All editors and reviewers hate wasting time on poorly prepared manuscripts and will reject



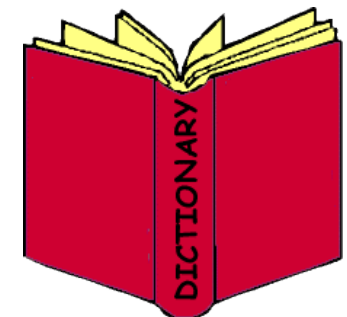
4. Language

- Write short and direct sentences
- Convey one piece of information per sentence
- Avoid multiple statements in one sentence
- The average length of sentences in scientific writing is only about 12-17 words
- Eliminate redundant phrases
- Double-check unfamiliar words or phrases
- Clearly explain abbreviations
- Use 'present tense' for known facts and hypotheses
- Use 'past tense' for conducted experiments and results



4. Language: use single words instead of phrases

a number of	several
a small number of	a few
are in agreement	agree
are found to be	are
at the present time	now
based on the fact that	because
despite the fact that	although
due to the fact that	because
fewer in number	fewer
for the reason that	because
if it is assumed that	if
in spite of the fact that	although
in the near future	soon
in view of the fact that	because
it is clear that	clearly
of great importance	important



5. Ensure paper is up-to-date and in right context

- Editors want to:
 - Understand how your work is related to previous research
 - Be sure that your work builds upon the most recent insights
 - Be sure all relevant (international) work has been taken into account

- For that purpose they will take a close look at:
 - Introduction
 - List of references



5. Ensure paper is up-to-date and in right context

- Introduction:
 - Your work is not an isolated piece of research
 - It builds upon earlier work and that should be described
 - A good paper should explain in the introduction:
 - The topic of the paper and the scientific field
 - The relevance and significance of the topic
 - A description of what has been done before, by whom and how
 - What is known and what is not known
 - Questions that remain



5. Ensure paper is up-to-date and in right context

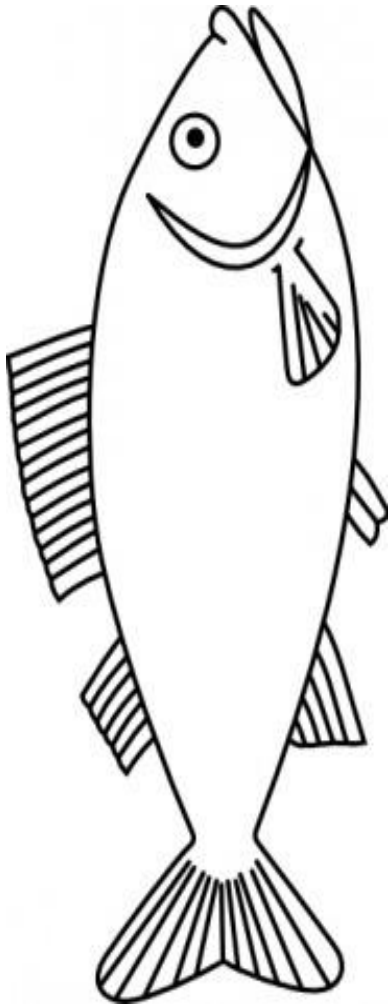
- Reference list
 - An editor will take a look at your reference list to see:
 - Are recent papers included?
 - Are papers from top-journal included?
 - Are leading scientists cited?
 - Are there too many self-cites?
 - Are references internationally distributed?



6. Use the correct article structure

- Scientific articles all have a precise structure that should be followed:
 - Title
 - Authors
 - Abstract
 - Keywords
 - Main text
 - Introduction
 - Methods
 - Results and discussion
 - Conclusion
 - Acknowledgements
 - References
 - Supplementary material

Typical Structure of a Research Article



- Title
- Authors
- Abstract
- Keywords

Make them easy for indexing and searching! (informative, attractive, effective)

- Main text (IMRAD)
 - Introduction
 - Methods
 - Results
 - And
 - Discussions

Journal space is not unlimited.

Your reader's time is scarce.

Make your article as concise as possible - more difficult than you imagine!

- Conclusion
- Acknowledgement
- References
- Supplementary Data

6. Use the correct article structure



- Title
- Authors
- Abstract
- Keywords

■ Title

- A good title should contain the fewest possible words that adequately describe the contents of a paper
- Choose an informative, objective and business-like title.
- The titles conveys the main findings of research and is specific, concise, complete and attracts readers

6. Use the correct article structure



- Title
- Authors
- Abstract
- Keywords

■ Authors

- First Author:
 - Conducts and/or supervises the data analysis and the proper presentation and interpretation of the results
 - Puts paper together and prepares final version
- Corresponding Author:
 - Best person to contact regarding paper, usually leader of research team.
- Co-Author(s):
 - Makes intellectual contributions to data analysis and interpretation
 - Reviews each paper draft and approves submission
 - Must be able to present, understand and defend the complete work.

6. Use the correct article structure



- Title
- Authors
- Abstract
- Keywords

■ Abstract

- The quality of an abstract will strongly influence the editor's decision
- The abstract summarizes in 50-300 words the problem, the method, the results and the conclusion
- The abstract gives sufficient details so the reader can decide whether or not to read the whole article
- Write the abstract last so it accurately reflects the article
- Abstract are usually freely available and available through abstract-databases (like Scopus)

6. Use the correct article structure

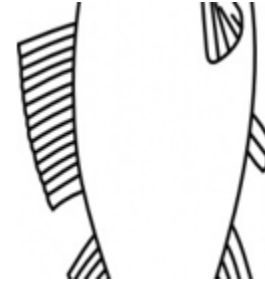


- Title
- Authors
- Abstract
- Keywords

■ Keywords

- Keywords: are important for indexing: they enable your manuscript to be more easily identified and cited. Keywords should be specific. Avoid uncommon abbreviations and general terms. Check guide-for-authors for specific keyword policy.

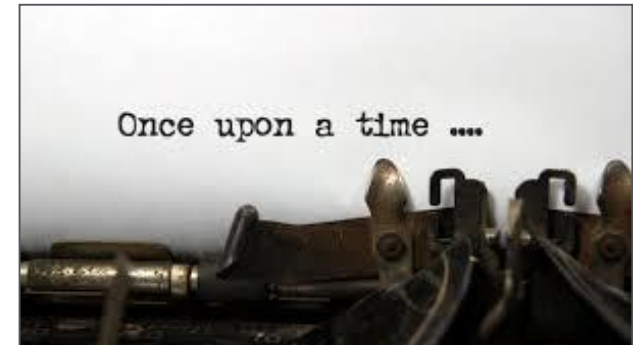
6. Use the correct article structure



- Main text (IMRAD)
 - Introduction
 - Methods
 - Results
 - And
 - Discussions

■ Introduction

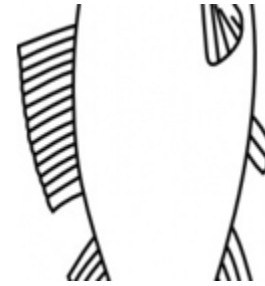
- Provide the necessary and balanced background information to put your work into context, but no extensive review
- Describe which knowledge already exists, what have others done before, include recent developments
- Define a question, a hypothesis
- Explain your approach
- It should be clear from the introduction:
 - Why the current work was performed: aim and significance



6. Use the correct article structure

■ Results and discussion

- Present your findings and explain what was found
- Guide your readers through data/tables/figures
- Be clear and present in logical sequence
- Highlight unusual or unexpected findings
- Clearly identify significant trends
- Do not repeat in words obvious details from tables and figures
- Provide all possible interpretations of your findings
- Explain why you come to certain conclusions
- Describe how the results relate to the study's aims and hypotheses
- Explain how the findings relate to those of other studies
- Mention the limitations of the study



- Main text (IMRAD)
 - Introduction
 - Methods
 - Results
 - And
 - Discussions

6. Use the correct article structure



- Conclusion
- Acknowledgement
- References
- Supplementary Data

■ Conclusions

- Be short
- Do not repeat exactly what has been written in preceding sections
- Summarize your main conclusions and make your key claims
- Put your work into context, with other work and also in relation to the aim of your study
- Suggest future work
- Do not over-emphasize your work
- Do not be too speculative



6. Use the correct article structure



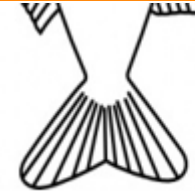
- Conclusion
- Acknowledgement
- References
- Supplementary Data

■ Acknowledgement

- Acknowledge anyone who has helped you with the study, including:
 - Researchers who supplied materials or reagents
 - Anyone who provided technical help
 - Funding sources
 - Anyone who helped with English language
 - Anyone who read manuscripts and provided comments
 - Explain why these people are acknowledged



6. Use the correct article structure



- Conclusion
- Acknowledgement
- References
- Supplementary Data

■ References

- Make sure you have a balanced and up-to-date reference list
- Include recent references, include worldwide references
- Make sure you fully understand the papers you are referencing and that citation makes sense.
- Avoid excessive self-citations and excessive citations of publications from the same region or journal
- Conform strictly to the style given in the Guide for Authors



7. Be prepared for common questions to reviewers

- Common questions include:
 - Does the topic of the paper fit within the journal?
 - Are title and abstract in line with content?
 - Is the introduction clear, balanced and well organized?
 - Are experiments correct? Can they be repeated based on description?
 - Comment on need and quality of tables/figures/images.
 - Are the results well-presented and analyzed?
 - Is research put in appropriate context?
 - Are references accurate, up-to-date, balanced, accessible?
 - Comment on importance, validity, generality of conclusions



Submitting a manuscript

Submitting a manuscript

- Check completeness of manuscript, including supplementary material (guide-for-authors)
- Prepare graphical abstracts/research highlights
- Write cover letter



Write a good cover letter

- This is your opportunity to convince the journal editor that they should publish your study. Take that opportunity!

- Briefly describe:
 - Yourself: your background, expertise research area, track record
 - Describe the research field, main developments, key-players
 - The main findings of this research and what is new
 - The significance of this research
 - The significance and relevance for journal

- Refer to previous papers on same topic in the journal.

- Keep it brief, but convey the particular importance of your manuscript to the journal



Write a good cover letter

- Suggest reviewers and volunteer as reviewer
 - Finding suitable reviewers is one of the toughest jobs for an editor.
 - Your suggestions will not necessarily be used.
 - Scientists do not like to review papers that do not match their expertise and interest. They will decline the invitation and the editor has to identify a new reviewer.
 - Scientists like to review papers if it deals with ‘their’ topic. They are usually willing to deliver good suggestions and criticism.
 - Suggesting good reviewers also shows that you know who are the leading experts in the field.
 - Suggest reviewers from different institutes/countries,
 - Describe why you suggest them (e.g. their specific expertise)
 - Also mention who should *not* review your paper and explain why.

Write a good cover letter



Dear Sir,

“The development of this class of compounds is a very active field of chemistry these days”

“We have studied these materials for many years and have published six papers on synthesis and properties....”

“Important contributions in this field have been made by....”

“Also in your journal several papers have focused on elucidating the mechanism of”

“A better understanding of this phenomena will lead to more environmentally-friendly....”

“Our laboratory has developed a specific technique that has enabled us to study”

“Prof. Smith would be a suitable reviewer due to his expertise in...”

Publishing ethics

Obey publishing ethics

- There are generally accepted ethical rules around scientific research and publishing to maintain integrity and trustworthiness of scientific work and reporting
- Rules and guidelines are specified by COPE (www.publicationethics.org)
- COPE is a forum for editors and publishers of peer reviewed journals to discuss all aspects of publication ethics. It also advises editors on how to handle cases of research and publication misconduct.
- Code of conduct, guidelines and flowcharts available at COPE website. Also many cases are reported and discussed.
- <https://www.youtube.com/watch?v=Mwbw9KF-ACY>



Obey publishing ethics!

- Submitting a paper implies that you are familiar with and have accepted publishing ethics, see
 - Guide for Authors
 - www.elsevier.com/publishingethics
- Also, during the submission process, you are asked to confirm a few declarations.
- Editors will reject papers if they observe any misconduct. They will make a note.
- Journals can retract published papers and state in public why a paper was retracted. They may also inform the institute management



Obey publishing ethics!

Unethical publishing behavior includes:

- Data fabrication and falsification
 - Making up data or results, and recording or reporting them
 - Manipulating data (for example images)

- Plagiarism
 - Plagiarism is the appropriation of another person's ideas, processes, results, or words without giving appropriate credit.
 - Serious offence that could lead to paper rejection, academic charges and termination of employment.
 - Publishers are using software to detect unethical behavior (CrossCheck)




Obey publishing ethics!

Unethical publishing behavior includes:



- Multiple submissions
 - Submission to a journal implies that it is not under consideration for publication elsewhere (see guide for authors).

- Improper author contribution
 - Leaving out authors who should be included
 - Including authors who did not contribute significantly

doi:10.1016/j.sigpro.2005.07.019  Cite or Link Using DOI
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RETRACTED: Matching pursuit-based approach

Available online 24 August 2005.

This article has been retracted at the request of the Editor-in-Chief and Publisher. For more information, please visit <http://www.elsevier.com/locate/withdrawalpolicy>.

Reason: This article is virtually identical to the previously published article "A matching pursuit-based approach for SNR improvement in ultrasonic NDT", *Independent Nondestructive Testing International*, volume 38 (2005) 453 – 458 authored by N. ...

An article in which the authors committed plagiarism: it will not be removed from ScienceDirect ever. Everybody who downloads it will see the reason for the retraction...

the echoes issuing from the flaws to be detected. Therefore, it cannot be cancelled by classical time averaging or matched band-pass filtering techniques.

Many signal processing techniques have been utilized for signal-to-noise ratio (SNR) improvement in ultrasonic NDT of highly scattering materials. The most popular one is the split spectrum processing (SSP) [1–3], because it makes possible real-time ultrasonic test for industrial applications, providing quite good results. Alternatively to SSP, wavelet transform (WT) based denoising/detection methods have been proposed during recent years [4–8], yielding usually to higher improvements of SNR at the expense of an increase in complexity. Adaptive time-frequency analysis by basis pursuit (BP) [9,10] is a recent technique for decomposing a signal into an optimal superposition of elements in an over-complete waveform dictionary. This technique and some other related techniques have been successfully applied to denoising ultrasonic signals contaminated with grain noise in highly scattering materials [11,12], as an alternative to the WT technique, the computational cost of the BP algorithm being the main drawback.

In this paper, we propose a novel matching pursuit-based signal processing method for improving SNR in ultrasonic NDT of highly scattering materials, such as steel and composites. Matching pursuit is used instead of BP to reduce the complexity. Despite its iterative nature, the method is fast enough to be real-time implemented. The performance of the proposed method has been evaluated using both computer simulation and experimental results, even when the input SNR (SNR_{in}) is lower than 0dB (the level of echoes from the microstructures is above the level of the echoes).

2. Matching pursuit

Matching pursuit was introduced by Mallat and Zhang [13]. Let us suppose an approximation of the ultrasonic backscattered signals $x[n]$ as a linear expansion in terms of functions $g_i[n]$ chosen from an over-complete dictionary. Let H be a Hilbert

space. We define the over-complete dictionary as a family $D = \{g_i; i=0, 1, \dots, L\}$ of vectors in H , such as $\|g_i\| = 1$.

The problem of choosing functions $g_i[n]$ that best approximate the analysed signal $x[n]$ is computationally very complex. Matching pursuit is an iterative algorithm that offers sub-optimal solutions for decomposing signals in terms of expansion functions chosen from a dictionary, where ℓ^1 norm is used as the approximation metric because of its mathematical convenience. When a well-designed dictionary is used in matching pursuit, the non-linear nature of the algorithm leads to compact and sparse signal models.

In each step of the iterative procedure, vector $g_i[n]$ which gives the largest inner product with the analysed signal is chosen. The contribution of this vector is then subtracted from the signal and the process is repeated on the residual. At the m th iteration the residue is

$$r^m[n] = \begin{cases} x[n] & m=0, \\ x[n] - \sum_{k=0}^{m-1} a_{k(m)} g_k[n], & m \neq 0, \end{cases} \quad (1)$$

where $a_{k(m)}$ is the weight associated to optimum atom $g_k[n] \in D$ at the m th iteration.

The weight a_i^m associated to each atom $g_i[n] \in D$ at the m th iteration is introduced to compute all the inner products with the residual $r^m[n]$:

$$a_i^m = \frac{\langle r^m[n], g_i[n] \rangle}{\langle g_i[n], g_i[n] \rangle} = \frac{\langle r^m[n], g_i[n] \rangle}{\|g_i[n]\|^2} = \langle r^m[n], g_i[n] \rangle. \quad (2)$$

The optimum atom $g_{k(m)}[n]$ (and its weight $a_{k(m)}$) at the m th iteration are obtained as follows:

$$g_{k(m)}[n] = \underset{g_i \in D}{\operatorname{argmin}} \|\langle r^{m-1}[n] \rangle\|^2 = \underset{g_i \in D}{\operatorname{argmax}} |\langle r^{m-1}[n] \rangle|. \quad (3)$$

The computation of correlations $\langle r^m[n], g_i[n] \rangle$ for all vectors $g_i[n]$ at each iteration implies a high computational effort, which can be substantially reduced using an updating procedure derived from Eq. (1). The correlation updating procedure [13] is performed as follows:

$$\langle r^{m+1}[n], g_i[n] \rangle = \langle r^m[n], g_i[n] \rangle - a_{k(m)} \langle g_{k(m)}[n], g_i[n] \rangle. \quad (4)$$

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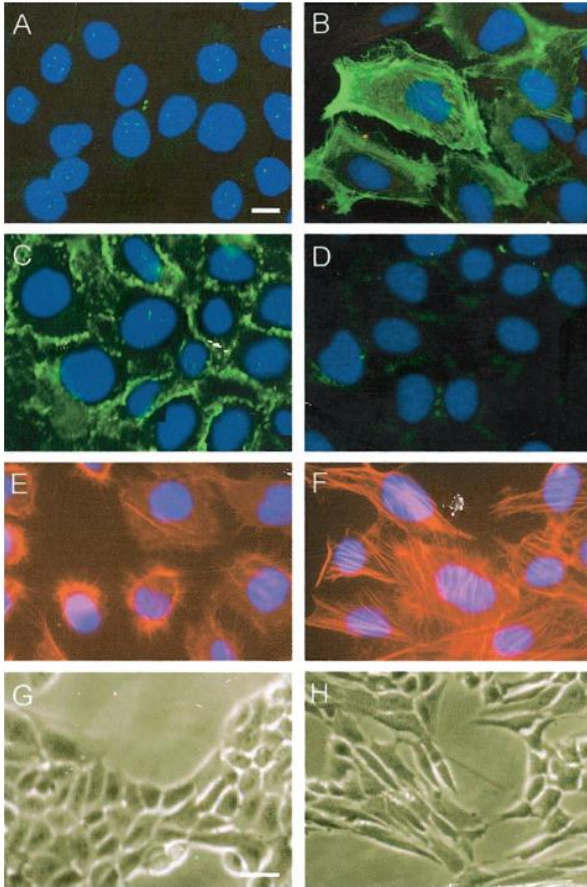
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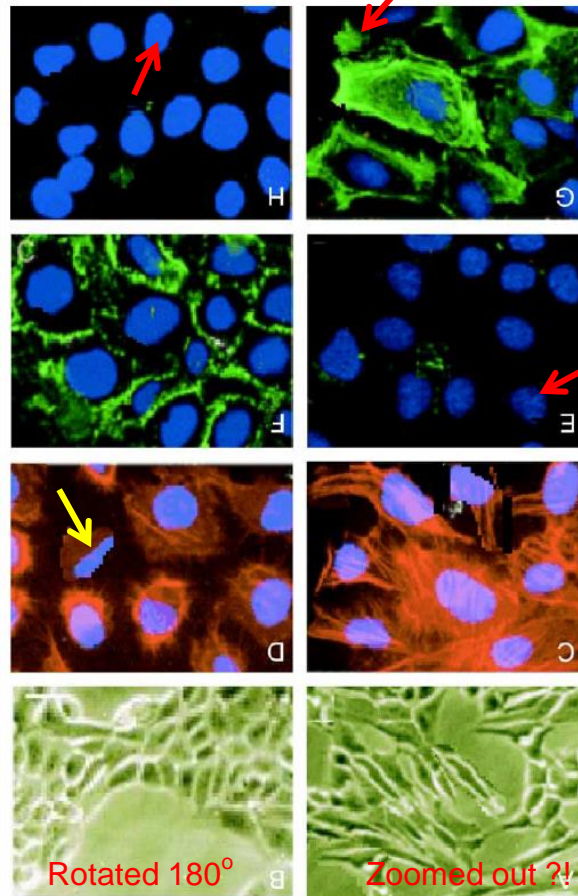


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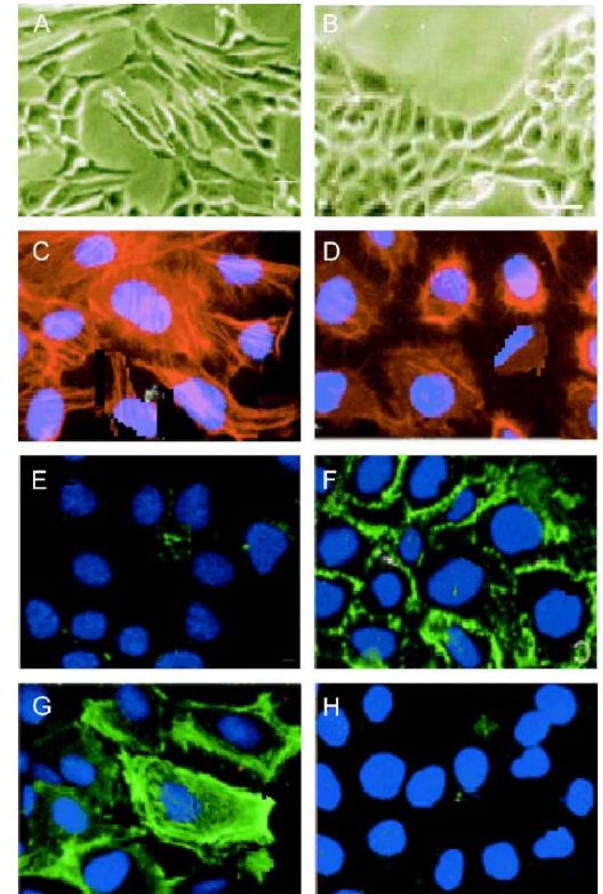
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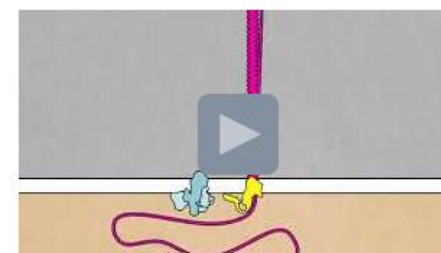
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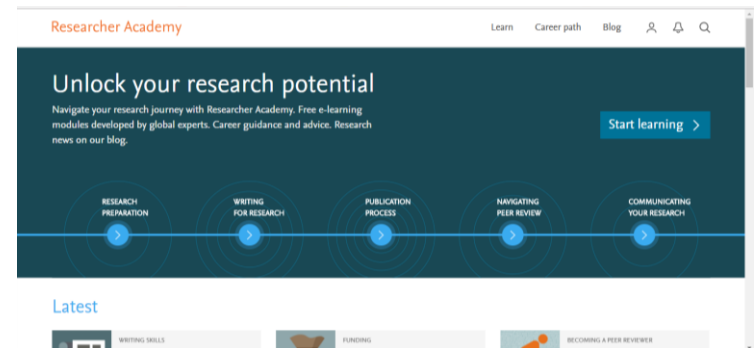
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