DESCRIPTION

To encourage the development of formal computing methods, and their application in biomedical research and medical practice, by illustration of fundamental principles in biomedical informatics research; to stimulate basic research into application software design; to report the state of research of biomedical information processing projects; to report new computer methodologies applied in biomedical areas; the eventual distribution of demonstrable software to avoid duplication of effort; to provide a forum for discussion and improvement of existing software; to optimize contact between national organizations and regional user groups by promoting an international exchange of information on formal methods, standards and software in biomedicine.

Computer Methods and Programs in Biomedicine covers computing methodology and software systems derived from computing science for implementation in all aspects of biomedical research and medical practice. It is designed to serve: biochemists; biologists; geneticists; immunologists; neuroscientists; pharmacologists; toxicologists; clinicians; epidemiologists; psychiatrists; psychologists; cardiologists; chemists; (radio)physicists; computer scientists; programmers and systems analysts; biomedical, clinical, electrical and other engineers; teachers of medical informatics and users of educational software.

Benefits to authors
We also provide many author benefits, such as free PDFs, a liberal copyright policy, special discounts on Elsevier publications and much more. Please click here for more information on our author services.

Please see our Guide for Authors for information on article submission. If you require any further information or help, please visit our support pages: http://service.elsevier.com

AUDIENCE

Life-Science Researchers, Clinicians, Statisticians, Health Scientists, Computer Scientists, Programmers and Bioengineers engaged in applying and teaching biomedical information processing.

IMPACT FACTOR

2018: 3.424 © Clarivate Analytics Journal Citation Reports 2019
ABSTRACTING AND INDEXING

Elsevier BIOBASE
Animal Breeding Abstracts
Abstracts on Hygiene and Communicable Diseases
BioEngineering Abstracts
Biological Abstracts
BIOSIS Previews
Biotechnology and Bioengineering Abstracts
CompuMath Citation Index
Current Contents
Current Index to Statistics
International Nursing Index
Embase
Nutrition Abstracts and Reviews Series
Referativnyi Zhurnal VINTI-RAN (Russian Academy of Sciences)
Statistical Theory and Method Abstracts
Telegen
Engineering Index
Abstracts of Mycology
AgBiotech News and Information
Computer Science Index
CAB International
Cancerlit
CSA Technology Research Database
EI Compendex
Global Health
Inside Conferences
Pascal Francis
Social SciSearch
TOXFILE
UnCover
BIOSIS Toxicology
Embase
Science Search
BIOSIS Citation Index
Computer and Control Abstracts
Current Contents - Life Sciences
Embase
PubMed/Medline
INSPEC
Computer Contents
Pascal Francis
Science Citation Index
Biomedical Engineering Citation Index
Scopus

EDITORIAL BOARD

Editor-in-Chief
Filippo Molinari, Polytechnic of Turin Department of Electronics and Telecommunications, corso Duca Degli Abruzzi 24, 10129, Torino, Italy

Associate Editors
Biocybernetics and Big Data
Usman Iqbal, Taipei Medical University International Center for Health Information Technology, 250-Wu-xing St. Xinyi District, 11031, Taipei, Taiwan
Modelling & Simulation
Ewart R. Carson, Queen Mary University of London School of Mathematical Science, 327 Mile End Road, E1 4NS, London, United Kingdom

Classification and interpretation
Rajendra Acharya, Ngee Ann Polytechnic, Singapore University of Social Sciences, 599489, Singapore, Singapore

Biomedical signal and image processing
Massimo Mischi, University of Technology Eindhoven, 5600 MB, Eindhoven, Netherlands

Health informatics and systems
Efthyvoulos Kyriacou, Frederick University - Limassol Campus, 3080, Lemesos, Cyprus

Data processing in biomedical engineering
Vinithasree Subbhuraam, Cyrcadia Health, Houston, Texas, United States

Editorial Board
J. G. Chase, Christchurch, New Zealand
I. Chouvarda, Thessaloniki, Greece
D D’Argenio, Los Angeles, California, United States
Y.C. Fann, Bethesda, Maryland, United States
D. Feng, Sydney, New South Wales, Australia
L Peterson, Houston, Texas, United States
R. Rosipal, Bratislava, Slovakia
M.G. Signorini, Milano, Italy
C. Tao, Houston, Texas, United States
F. Zhou, Changchun, Jilin, China
GUIDE FOR AUTHORS

Your Paper Your Way
We now differentiate between the requirements for new and revised submissions. You may choose to submit your manuscript as a single Word or PDF file to be used in the refereeing process. Only when your paper is at the revision stage, will you be requested to put your paper in to a 'correct format' for acceptance and provide the items required for the publication of your article.

To find out more, please visit the Preparation section below.

INTRODUCTION

Computer Methods and Programs in Biomedicine is available through Elsevier's Electronic Submission System (Evise) https://www.evise.com/profile/#/CMPB/

Computer Methods and Programs in Biomedicine is dedicated to the scientific development, implementation and exchange of formal methods and computer software systems in biomedical research and medical practice. It is designed to serve biomedical researchers; biomedical and clinical / health informaticians; medical researchers and practitioners; biologists; biochemists; biophysicists; geneticists; neuroscientists; psychologists; epidemiologists; immunologists; pharmacologists; biostatisticians; computer scientists, programmers and systems analysts; biomedical, clinical and other engineers; teachers of medical informatics and users of educational software. The aims of the journal are: (1) to encourage the development of formal computing methods, and their application in biomedical research and medical practice, by illustration of fundamental principles in biomedical informatics; (2) to stimulate basic research into biomedical application software design; (3) to report the state of research of biomedical information processing projects; (4) to report new computer methodologies applied in biomedical areas; (5) to provide a forum for discussion and exchange of existing software, by describing implementations that can be directly used by other interested researchers; (6) to optimise contact between national organisations and regional user groups by promoting an international exchange of information on formal methods, standards and software in biomedicine; (7) to announce and report meetings of central interest.

Field of Interest

The application of computer science methodology and software to the full range of theoretical and clinical biomedical specialties, including: Biochemistry; Biophysics; Molecular biology; Genetics; Immunology; Microbiology; Cardiology; Neurophysiology; Radiotherapy; Pharmacology; Clinical psychology; Psychophysiology and social medicine; Biomedical informatics; Biostatistics; Biomedical mathematics and cybernetics; Biomedical, clinical and electrical engineering; Clinical decision support; Hospital information systems; Process control; Medical imaging; Ambulatory monitoring.

Contents

In Focus Papers These include: state of research papers on ongoing projects; future trends; software applications; computer-aided instruction in the laboratory and clinical practice; evolving hardware and software technology and its influence on health application design; developments in the science of biomedical computing, and areas listed under 'Section I. Methodology' below

Section I. Methodology

Papers on methodology in established and maturing areas such as: (1) artificial intelligence; (2) man/machine interaction and interfaces (e.g., CAI, CAL, CAD/CAM, Decision support systems and voice-computer interaction); (3) database management; (4) biomedical modelling and simulation; (5) signal analysis; (6) image processing; (7) biosignal-based electronic prosthesis; (8) computer control of laboratory machines and devices; (9) computer communication networks; (10) computer architecture/software interaction, may be structured as follows:

1. Introduction. A discussion of the research or clinical issues underlying a project's design, the need for the methodology / system, and any pilot studies done to demonstrate the demand for, or feasibility of, such a methodology / system.

2 Background. This should be divided into two subtopics: a discussion of prior work by the authors that led to the current design decisions; and an analysis of related work in the literature. An acknowledgment, analysis and integration of lessons from related work by others is crucial.
3. **Design considerations.** A discussion of the principle design, performance and implementation goals, against which the success of the methodology / system should be assessed.

4. **Description of method / system.** A description of the theoretical basis of the computational method. A technical exposition of the overall architecture, the pertinent data structures, control mechanisms, etc. and a brief description of the hardware used, is required.

5. **Status report.** A description of the current status of the implementation, informal indicators of the strengths and weaknesses of the methodology / system, and examples of its current level of performance are required.

6. **Lessons learned.** An analysis of the key insights gained from the work to date, focusing on the statement of general principles that can contribute to the knowledge in the field. The statement of such lessons must be well supported by examples. The emphasis should be on the statement of principles in such a form that they will be of use to other investigators in the field.

7. **Mode of availability of software.** The availability of demonstration/application software is a preferential criterion for acceptance.

8. **Future plans.** A discussion of how the research to date, and the lessons learned, have led to a specification of future research goals, and possible revisions in the design and implementation of the method / system.

9. **References.** A listing of literature consulted in order of citation in the text, according to the standard abbreviations and form described under 'Manuscript preparation' below.

**Section II. Systems and program**

In addition to papers describing software related to the methodology section above, papers on biomedical computer applications, original from the point of view of theoretical or technological approach, or describing the adaptation of existing software to the solution of specific problems, may be considered. No restrictions are made on the use of computer languages; the description and exchange of software widely applied in biomedical research and medical practice is considered of most importance. Papers on programs intended for Section II should cover the following items: (i) Introduction; (ii) Computational methods and theory; (iii) System or program description, preferably with structograms, or block diagrams and flow charts; (iv) Samples of typical system or program runs; (v) Hardware and software specifications; (vi) Mode of availability of the system or program; clear information is required; (vii) Listing of literature in order of citation in the text; (viii) Appendix expanding, when necessary, material in the text.

**Section III. Experiences with methods, systems and programs - Reader's forum**

Evaluation of methods and software applications, comments on existing computer applications published in related books or journals, and discussions of practical problems related to biomedical computing are invited from users. Cross evaluations of specific hardware and software, and letters to the Editor, are welcome.

Authors of methodological papers and systems and programs papers are encouraged to make their code or software programs available to others, in the first case in form of demonstration code, and in the second case as usable applications with suitable user interface.

**International news**

International conferences, regional symposia and workshops are announced and reported. Newsletters from biomedical informatics associations are abstracted.

**Publications reviews**

Relevant books, journals and software products received are listed or reviewed. Promotion material for recent publications is abstracted.
Submission checklist

You can use this list to carry out a final check of your submission before you send it to the journal for review. Please check the relevant section in this Guide for Authors for more details.

Ensure that the following items are present:

One author has been designated as the corresponding author with contact details:
• E-mail address
• Full postal address

All necessary files have been uploaded:

Manuscript:
• Include keywords
• All figures (include relevant captions)
• All tables (including titles, description, footnotes)
• Ensure all figure and table citations in the text match the files provided
• Indicate clearly if color should be used for any figures in print

Graphical Abstracts / Highlights files (where applicable)

Supplemental files (where applicable)

Further considerations
• Manuscript has been ‘spell checked’ and ‘grammar checked’
• All references mentioned in the Reference List are cited in the text, and vice versa
• Permission has been obtained for use of copyrighted material from other sources (including the Internet)
• A competing interests statement is provided, even if the authors have no competing interests to declare
• Journal policies detailed in this guide have been reviewed
• Referee suggestions and contact details provided, based on journal requirements

For further information, visit our Support Center.

BEFORE YOU BEGIN

Ethics in publishing

Please see our information pages on Ethics in publishing and Ethical guidelines for journal publication.

Work on human beings that is submitted to Computer Methods and Programs in Biomedicine should comply with the principles laid down in the Declaration of Helsinki; Recommendations guiding physicians in biomedical research involving human subjects. Adopted by the 18th World Medical Assembly, Helsinki, Finland, June 1964, amended by the 29th World Medical Assembly, Tokyo, Japan, October 1975, the 35th World Medical Assembly, Venice, Italy, October 1983, and the 41st World Medical Assembly, Hong Kong, September 1989. The manuscript should contain a statement that the work has been approved by the appropriate ethical committees related to the institution(s) in which it was performed and that subjects gave informed consent to the work. Studies involving experiments with animals must state that their care was in accordance with institution guidelines.

Studies on patients or volunteers require ethics committee approval and informed consent which should be documented in your paper. Patients have a right to privacy. Therefore identifying information, including patients’ images, names, initials, or hospital numbers, should not be included in videos, recordings, written descriptions, photographs, and pedigrees unless the information is essential for scientific purposes and you have obtained written informed consent for publication in print and electronic form from the patient (or parent, guardian or next of kin where applicable). If such consent is made subject to any conditions, Elsevier must be made aware of all such conditions. Written consents must be provided to Elsevier on request. Even where consent has been given, identifying details should be omitted if they are not essential. If identifying characteristics are altered to protect anonymity, such as in genetic pedigrees, authors should provide assurance that alterations do not distort scientific meaning and editors should so note. If such consent has not been obtained, personal details of patients included in any part of the paper and in any supplementary materials (including all illustrations and videos) must be removed before submission.
Conflicts of Interest
At the end of the text, under a subheading "Conflict of interest statement" all authors must disclose any financial and personal relationships with other people or organisations that could inappropriately influence (bias) their work. Examples of potential conflicts of interest include employment, consultancies, stock ownership, honoraria, paid expert testimony, patent applications/registrations, and grants or other funding.

Submission declaration
Submission of an article implies that the work described has not been published previously (except in the form of an abstract, a published lecture or academic thesis, see 'Multiple, redundant or concurrent publication' for more information), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder.

Preprints
Please note that preprints can be shared anywhere at any time, in line with Elsevier's sharing policy. Sharing your preprints e.g. on a preprint server will not count as prior publication (see 'Multiple, redundant or concurrent publication' for more information).

Use of inclusive language
Inclusive language acknowledges diversity, conveys respect to all people, is sensitive to differences, and promotes equal opportunities. Articles should make no assumptions about the beliefs or commitments of any reader, should contain nothing which might imply that one individual is superior to another on the grounds of race, sex, culture or any other characteristic, and should use inclusive language throughout. Authors should ensure that writing is free from bias, for instance by using 'he or she', 'his/her' instead of 'he' or 'his', and by making use of job titles that are free of stereotyping (e.g. 'chairperson' instead of 'chairman' and 'flight attendant' instead of 'stewardess').

Changes to authorship
Authors are expected to consider carefully the list and order of authors before submitting their manuscript and provide the definitive list of authors at the time of the original submission. Any addition, deletion or rearrangement of author names in the authorship list should be made only before the manuscript has been accepted and only if approved by the journal Editor. To request such a change, the Editor must receive the following from the corresponding author: (a) the reason for the change in author list and (b) written confirmation (e-mail, letter) from all authors that they agree with the addition, removal or rearrangement. In the case of addition or removal of authors, this includes confirmation from the author being added or removed. Only in exceptional circumstances will the Editor consider the addition, deletion or rearrangement of authors after the manuscript has been accepted. While the Editor considers the request, publication of the manuscript will be suspended. If the manuscript has already been published in an online issue, any requests approved by the Editor will result in a corrigendum.

Copyright
Upon acceptance of an article, authors will be asked to complete a 'Journal Publishing Agreement' (see more information on this). An e-mail will be sent to the corresponding author confirming receipt of the manuscript together with a 'Journal Publishing Agreement' form or a link to the online version of this agreement.

Subscribers may reproduce tables of contents or prepare lists of articles including abstracts for internal circulation within their institutions. Permission of the Publisher is required for resale or distribution outside the institution and for all other derivative works, including compilations and translations. If excerpts from other copyrighted works are included, the author(s) must obtain written permission from the copyright owners and credit the source(s) in the article. Elsevier has preprinted forms for use by authors in these cases.

For gold open access articles: Upon acceptance of an article, authors will be asked to complete an 'Exclusive License Agreement' (more information). Permitted third party reuse of gold open access articles is determined by the author's choice of user license.

Author rights
As an author you (or your employer or institution) have certain rights to reuse your work. More information.

Elsevier supports responsible sharing
Find out how you can share your research published in Elsevier journals.

Role of the funding source
You are requested to identify who provided financial support for the conduct of the research and/or preparation of the article and to briefly describe the role of the sponsor(s), if any, in study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the article for publication. If the funding source(s) had no such involvement then this should be stated.

All sources of funding should be declared as an acknowledgement at the end of the text. Authors should declare the role of study sponsors, if any, in the study design, in the collection, analysis and interpretation of data; in the writing of the manuscript; and in the decision to submit the manuscript for publication. If the study sponsors had no such involvement, the authors should so state.

Funding body agreements and policies
Elsevier has established a number of agreements with funding bodies which allow authors to comply with their funder's open access policies. Some funding bodies will reimburse the author for the gold open access publication fee. Details of existing agreements are available online.

After acceptance, open access papers will be published under a noncommercial license. For authors requiring a commercial CC BY license, you can apply after your manuscript is accepted for publication.

Open access
This journal offers authors a choice in publishing their research:

Subscription
- Articles are made available to subscribers as well as developing countries and patient groups through our universal access programs.
- No open access publication fee payable by authors.
- The Author is entitled to post the accepted manuscript in their institution's repository and make this public after an embargo period (known as green Open Access). The published journal article cannot be shared publicly, for example on ResearchGate or Academia.edu, to ensure the sustainability of peer-reviewed research in journal publications. The embargo period for this journal can be found below.

Gold open access
- Articles are freely available to both subscribers and the wider public with permitted reuse.
- A gold open access publication fee is payable by authors or on their behalf, e.g. by their research funder or institution.

Regardless of how you choose to publish your article, the journal will apply the same peer review criteria and acceptance standards.

For gold open access articles, permitted third party (re)use is defined by the following Creative Commons user licenses:

Creative Commons Attribution-NonCommercial-NoDerivs (CC BY-NC-ND)
For non-commercial purposes, lets others distribute and copy the article, and to include in a collective work (such as an anthology), as long as they credit the author(s) and provided they do not alter or modify the article.

This journal does not ordinarily have publication charges; however, authors can now opt to make their articles available to all (including non-subscribers) via the ScienceDirect platform, for which a fee of US $2500 applies (for further information on open access see https://www.elsevier.com/about/open-access/open-access-options). Please note that you can only make this choice after receiving notification that your article has been accepted for publication, to avoid any perception of conflict of interest. The fee excludes taxes and other potential costs such as color charges. In some cases, institutions and funding bodies have entered into agreement with Elsevier to meet these fees on behalf of their authors. Details of these agreements are available at https://www.elsevier.com/fundingbodies. Authors of accepted articles, who wish to take advantage of this option, should complete and submit the order form (available at
Whatever access option you choose, you retain many rights as an author, including the right to post a revised personal version of your article on your own website. More information can be found here: [https://www.elsevier.com/authorsrights](https://www.elsevier.com/authorsrights). Your publication choice will have no effect on the peer review process or acceptance of submitted articles.

The gold open access publication fee for this journal is **USD 3000**, excluding taxes. Learn more about Elsevier's pricing policy: [https://www.elsevier.com/openaccesspricing](https://www.elsevier.com/openaccesspricing).

**Green open access**

Authors can share their research in a variety of different ways and Elsevier has a number of green open access options available. We recommend authors see our open access page for further information. Authors can also self-archive their manuscripts immediately and enable public access from their institution's repository after an embargo period. This is the version that has been accepted for publication and which typically includes author-incorporated changes suggested during submission, peer review and in editor-author communications. Embargo period: For subscription articles, an appropriate amount of time is needed for journals to deliver value to subscribing customers before an article becomes freely available to the public. This is the embargo period and it begins from the date the article is formally published online in its final and fully citable form. Find out more.

This journal has an embargo period of 12 months.

**Elsevier Researcher Academy**

Researcher Academy is a free e-learning platform designed to support early and mid-career researchers throughout their research journey. The "Learn" environment at Researcher Academy offers several interactive modules, webinars, downloadable guides and resources to guide you through the process of writing for research and going through peer review. Feel free to use these free resources to improve your submission and navigate the publication process with ease.

**Language (usage and editing services)**

Please write your text in good English (American or British usage is accepted, but not a mixture of these). Authors who feel their English language manuscript may require editing to eliminate possible grammatical or spelling errors and to conform to correct scientific English may wish to use the English Language Editing service available from Elsevier’s Author Services.

**Language Editing**

International Science Editing and Asia Science Editing can provide English language and copyediting services to authors who need assistance before they submit their article or before it is accepted for publication. Authors can contact these services directly: International Science Editing [http://www.internationalscienceediting.com](http://www.internationalscienceediting.com) and Asia Science Editing [http://www.asiascienceediting.com](http://www.asiascienceediting.com) or, for more information about language editing services, please visit our Support Center.

**Submission of Articles**

Manuscripts are accepted on the understanding that they report unpublished work that is not under consideration elsewhere, that all authors have agreed to its submission and that, if accepted, it will not be published again in the same form, in any language, without the prior consent of the publisher. All authors should have made substantial contributions to all of the following: (1) the conception and design of the study, or acquisition of data, or analysis and interpretation of data, (2) drafting the article or revising it critically for important intellectual content, (3) final approval of the version to be submitted. Authors who wish to submit papers for publication are requested to submit their manuscripts and figures online via the Elsevier Editorial System (Evise): [https://www.evise.com/profile/#/CMPB/](https://www.evise.com/profile/#/CMPB/) to the editor for the relevant geographical area (see below).

EES is a web-based submission and review system. Authors may submit manuscripts and track their progress through the system to publication. In case of technical submission problems, please visit our Support Center.

Authors are requested to submit their manuscripts and figures online via the Elsevier Editorial System (Evise): [https://www.evise.com/profile/#/CMPB/](https://www.evise.com/profile/#/CMPB/) to the Editor-in-Chief (details below):

**Editor:** Prof. Filippo Molinari, PhD., Biolab - Department of Electronics and Telecommunications, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Torino, Italy. E-mail: filippo.molinari@polito.it
All special issue papers should be sent to the Editor-in-Chief who will assign them to the appropriate Managing Guest Editor. Authors should clearly state the title of the special issue their manuscript is intended for.

As a service to the community, this journal makes available online the accepted manuscripts as soon as possible after acceptance. At this stage, the author's accepted manuscript (in both full-text and PDF) is given a Digital Object Identifier (DOI) and is fully citable, and searchable by title, author(s) name and the full-text. The article also carries a disclaimer noting that it is an unedited manuscript which has not yet been copyedited, typeset or proofread. When the fully copyedited version is ready for publication, it simply replaces the author accepted manuscript version.

Submit your article
Please submit your article via https://www.evise.com/profile/#/CMPB/.

PREPARATION

**Manuscript**

**Covering Letter**

The letter must contain: why the submission is appropriate for publication in Computer Methods and Programs in Biomedicine; what is known about the topic discussed; what your study adds; and confirmation that the paper has not been published elsewhere. **Title Page**

A separate sheet should include the title, the names and full addresses of the authors, and the name, full postal and email address and telephone number of the author for correspondence. Title should not be all capitals. **The Original research manuscript**

Manuscripts should be typed in English with double spacing and wide margins. should not normally exceed 3500 words excluding abstract of 350 words. References up to 50 and no specific limits for Tables and Figures. Greek letters and mathematical symbols should be defined initially in the margin.

**Abstract**. This should be structured under the following headings: Background and Objectives Methods Results Conclusions **Keywords.** 3-6 keywords should follow the abstract

The Abstract of the manuscript should not exceed 350 words and must be structured into separate sections: Background and Objective: the context and purpose of the study; Methods: how the study was performed and statistical tests used; Results: the main findings including evaluation with precision, sensitivity and specificity values; Conclusions: brief summary and potential implications. Please minimize the use of abbreviations and do not cite references in the abstract. • Introduction • Methods • Results • Discussion • Acknowledgements including declarations: Statements of ethical approval, funding and competing interests.

**The Reviews manuscript** Review articles contain systematic reviews of the literature on topics of broad interest to the readers or target audience and scope (covered topics). The structured abstract and text for a systematic review should follow the same format as described above with the word count: up to 4000 words excluding abstract of 350 words, Tables and Figures in total up to 5 with unlimited References. **Letters to the Editor**

Letters to the Editor are considered for publication as provided they do not contain material that has been submitted or published elsewhere.

Letters in reference to a Journal article must not exceed 1000 words (excluding references), and must be received within three weeks after publication of the article.

Letters not related to a Journal article must not exceed 1500 words (excluding references) and contains no more than five references and one figure or table.

**NEW SUBMISSIONS**

Submission to this journal proceeds totally online and you will be guided stepwise through the creation and uploading of your files. The system automatically converts your files to a single PDF file, which is used in the peer-review process.
As part of the Your Paper Your Way service, you may choose to submit your manuscript as a single file to be used in the refereeing process. This can be a PDF file or a Word document, in any format or layout that can be used by referees to evaluate your manuscript. It should contain high enough quality figures for refereeing. If you prefer to do so, you may still provide all or some of the source files at the initial submission. Please note that individual figure files larger than 10 MB must be uploaded separately.

References
There are no strict requirements on reference formatting at submission. References can be in any style or format as long as the style is consistent. Where applicable, author(s) name(s), journal title/book title, chapter title/article title, year of publication, volume number/book chapter and the article number or pagination must be present. Use of DOI is highly encouraged. The reference style used by the journal will be applied to the accepted article by Elsevier at the proof stage. Note that missing data will be highlighted at proof stage for the author to correct.

Formatting requirements
There are no strict formatting requirements but all manuscripts must contain the essential elements needed to convey your manuscript, for example Abstract, Keywords, Introduction, Materials and Methods, Results, Conclusions, Artwork and Tables with Captions.
If your article includes any Videos and/or other Supplementary material, this should be included in your initial submission for peer review purposes.
Divide the article into clearly defined sections.

Figures and tables embedded in text
Please ensure the figures and the tables included in the single file are placed next to the relevant text in the manuscript, rather than at the bottom or the top of the file. The corresponding caption should be placed directly below the figure or table.

Peer review
This journal operates a single blind review process. All contributions will be initially assessed by the editor for suitability for the journal. Papers deemed suitable are then typically sent to a minimum of two independent expert reviewers to assess the scientific quality of the paper. The Editor is responsible for the final decision regarding acceptance or rejection of articles. The Editor's decision is final. More information on types of peer review.

REVISED SUBMISSIONS
Use of word processing software
Regardless of the file format of the original submission, at revision you must provide us with an editable file of the entire article. Keep the layout of the text as simple as possible. Most formatting codes will be removed and replaced on processing the article. The electronic text should be prepared in a way very similar to that of conventional manuscripts (see also the Guide to Publishing with Elsevier). See also the section on Electronic artwork.
To avoid unnecessary errors you are strongly advised to use the 'spell-check' and 'grammar-check' functions of your word processor.

Article structure
Subdivision - numbered sections
Divide your article into clearly defined and numbered sections. Subsections should be numbered 1.1 (then 1.1.1, 1.1.2, ...), 1.2, etc. (the abstract is not included in section numbering). Use this numbering also for internal cross-referencing: do not just refer to 'the text'. Any subsection may be given a brief heading. Each heading should appear on its own separate line.

Introduction
State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results.

Material and methods
Provide sufficient details to allow the work to be reproduced by an independent researcher. Methods that are already published should be summarized, and indicated by a reference. If quoting directly from a previously published method, use quotation marks and also cite the source. Any modifications to existing methods should also be described.
Theory/calculation
A Theory section should extend, not repeat, the background to the article already dealt with in the Introduction and lay the foundation for further work. In contrast, a Calculation section represents a practical development from a theoretical basis.

Results
Results should be clear and concise.

Discussion
This should explore the significance of the results of the work, not repeat them. A combined Results and Discussion section is often appropriate. Avoid extensive citations and discussion of published literature.

Conclusions
The main conclusions of the study may be presented in a short Conclusions section, which may stand alone or form a subsection of a Discussion or Results and Discussion section.

Appendices
If there is more than one appendix, they should be identified as A, B, etc. Formulae and equations in appendices should be given separate numbering: Eq. (A.1), Eq. (A.2), etc.; in a subsequent appendix, Eq. (B.1) and so on. Similarly for tables and figures: Table A.1; Fig. A.1, etc.

Essential title page information
• Title. Concise and informative. Titles are often used in information-retrieval systems. Avoid abbreviations and formulae where possible.
• Author names and affiliations. Please clearly indicate the given name(s) and family name(s) of each author and check that all names are accurately spelled. You can add your name between parentheses in your own script behind the English transliteration. Present the authors' affiliation addresses (where the actual work was done) below the names. Indicate all affiliations with a lowercase superscript letter immediately after the author's name and in front of the appropriate address. Provide the full postal address of each affiliation, including the country name and, if available, the e-mail address of each author.
• Corresponding author. Clearly indicate who will handle correspondence at all stages of refereeing and publication, also post-publication. This responsibility includes answering any future queries about Methodology and Materials. Ensure that the e-mail address is given and that contact details are kept up to date by the corresponding author.
• Present/permanent address. If an author has moved since the work described in the article was done, or was visiting at the time, a 'Present address' (or 'Permanent address') may be indicated as a footnote to that author's name. The address at which the author actually did the work must be retained as the main, affiliation address. Superscript Arabic numerals are used for such footnotes.

Title Page
A separate sheet should include the title, the names and full addresses of the authors, a concise but complete abstract of about 150 words, 3-6 key words for indexing purposes, and the name, full postal and email address and telephone number of the author for correspondence.

Highlights
Highlights are optional yet highly encouraged for this journal, as they increase the discoverability of your article via search engines. They consist of a short collection of bullet points that capture the novel results of your research as well as new methods that were used during the study (if any). Please have a look at the examples here: example Highlights.

Highlights should be submitted in a separate editable file in the online submission system. Please use 'Highlights' in the file name and include 3 to 5 bullet points (maximum 85 characters, including spaces, per bullet point).

Keywords
Immediately after the abstract, provide a maximum of 6 keywords, using American spelling and avoiding general and plural terms and multiple concepts (avoid, for example, 'and', 'of'). Be sparing with abbreviations: only abbreviations firmly established in the field may be eligible. These keywords will be used for indexing purposes.
Abbreviations
Define abbreviations that are not standard in this field in a footnote to be placed on the first page of the article. Such abbreviations that are unavoidable in the abstract must be defined at their first mention there, as well as in the footnote. Ensure consistency of abbreviations throughout the article.

Acknowledgement
All contributors who do not meet the criteria for authorship as defined above should be listed in an acknowledgements section. Examples of those who might be acknowledged include a person who provided purely technical help, writing assistance, or a department chair who provided only general support. Authors should disclose whether they had any writing assistance and identify the entity that paid for this assistance.

Formatting of funding sources
List funding sources in this standard way to facilitate compliance to funder’s requirements:

Funding: This work was supported by the National Institutes of Health [grant numbers xxxx, yyyy]; the Bill & Melinda Gates Foundation, Seattle, WA [grant number zzzz]; and the United States Institutes of Peace [grant number aaaa].

It is not necessary to include detailed descriptions on the program or type of grants and awards. When funding is from a block grant or other resources available to a university, college, or other research institution, submit the name of the institute or organization that provided the funding.

If no funding has been provided for the research, please include the following sentence:

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Math formulae
Please submit math equations as editable text and not as images. Present simple formulae in line with normal text where possible and use the solidus (/) instead of a horizontal line for small fractional terms, e.g., X/Y. In principle, variables are to be presented in italics. Powers of e are often more conveniently denoted by exp. Number consecutively any equations that have to be displayed separately from the text (if referred to explicitly in the text).

Footnotes
Footnotes should be used sparingly. Number them consecutively throughout the article. Many word processors build footnotes into the text, and this feature may be used. Should this not be the case, indicate the position of footnotes in the text and present the footnotes themselves separately at the end of the article.

Artwork
Electronic illustrations
Artwork should also be submitted in an electronic format as this allows the production of images to the best possible standards, ensuring accuracy, clarity and a high level of detail. Make sure that uniform lettering and sizing of the original artwork is used, and save text as "graphics" or enclose the font. Please use only the following fonts in your illustrations: Arial, Courier, Helvetica, Times, Symbol. Number the illustrations according to their sequence within the text. Use a logical naming system for the artwork files, and supply a separate listing of the files and the software used. All illustrations should be provided as separate files. Images should be produced near to the desired size of the printed version. Files can be stored on 3 1/2 inch diskette, ZIP-disk or CD (either MS-DOS or Macintosh). A detailed guide on electronic artwork is available on our website: https://www.elsevier.com/artworkinstructions.

Hardware and Software Specifications
A brief but complete description, including the language used, the computer specifications and special equipment, the amount of computer time and memory required by the program, etc., should be given.

Line Drawings
The lettering and symbols, as well as other details, should have proportionate dimensions, so as not to become illegible or unclear after possible reduction; in general, the figures should be designed for a reduction factor of two to three. The degree of reduction will be determined by the Publisher.
Illustrations will not be enlarged. Consider the page format of the journal when designing the illustrations. Dye-line prints or photocopies are not suitable for reproduction. Do not use any type of shading on computer-generated illustrations.

Electronic artwork

General points
- Make sure you use uniform lettering and sizing of your original artwork.
- Preferred fonts: Arial (or Helvetica), Times New Roman (or Times), Symbol, Courier.
- Number the illustrations according to their sequence in the text.
- Use a logical naming convention for your artwork files.
- Indicate per figure if it is a single, 1.5 or 2-column fitting image.
- For Word submissions only, you may still provide figures and their captions, and tables within a single file at the revision stage.
- Please note that individual figure files larger than 10 MB must be provided in separate source files.

A detailed guide on electronic artwork is available.

You are urged to visit this site; some excerpts from the detailed information are given here.

Formats
Regardless of the application used, when your electronic artwork is finalized, please 'save as' or convert the images to one of the following formats (note the resolution requirements for line drawings, halftones, and line/halftone combinations given below):
- EPS (or PDF): Vector drawings. Embed the font or save the text as 'graphics'.
- TIFF (or JPEG): Color or grayscale photographs (halftones): always use a minimum of 300 dpi.
- TIFF (or JPEG): Bitmapped line drawings: use a minimum of 1000 dpi.
- TIFF (or JPEG): Combinations bitmapped line/halftone (color or grayscale): a minimum of 500 dpi is required.

Please do not:
- Supply files that are optimized for screen use (e.g., GIF, BMP, PICT, WPG); the resolution is too low.
- Supply files that are too low in resolution.
- Submit graphics that are disproportionately large for the content.

Data input forms (optimal mark sheets, etc.)
If notations are not in the English language, a translation of terms should be given.

Color artwork
Please make sure that artwork files are in an acceptable format (TIFF (or JPEG), EPS (or PDF) or MS Office files) and with the correct resolution. If, together with your accepted article, you submit usable color figures then Elsevier will ensure, at no additional charge, that these figures will appear in color online (e.g., ScienceDirect and other sites) in addition to color reproduction in print. Further information on the preparation of electronic artwork.

Photographs
Please supply high quality files of sharp images with good contrast. Remove non-essential areas of a photograph. Do not mount photographs unless they form part of a composite figure. Where necessary, insert a scale bar in the illustration (not below it), as opposed to giving a magnification factor in the legend. Note that photocopies of photographs are not acceptable.

Illustration services
Elsevier's Author Services offers Illustration Services to authors preparing to submit a manuscript but concerned about the quality of the images accompanying their article. Elsevier's expert illustrators can produce scientific, technical and medical-style images, as well as a full range of charts, tables and graphs. Image 'polishing' is also available, where our illustrators take your image(s) and improve them to a professional standard. Please visit the website to find out more.

Caption
Ensure that each illustration has a caption. A caption should comprise a brief title (not on the figure itself) and a description of the illustration. Keep text in the illustrations themselves to a minimum but explain all symbols and abbreviations used.

Figure captions
Ensure that each illustration has a caption. A caption should comprise a brief title (not on the figure itself) and a description of the illustration. Keep text in the illustrations themselves to a minimum but explain all symbols and abbreviations used.
Tables
Please submit tables as editable text and not as images. Tables can be placed either next to the relevant text in the article, or on separate page(s) at the end. Number tables consecutively in accordance with their appearance in the text and place any table notes below the table body. Be sparing in the use of tables and ensure that the data presented in them do not duplicate results described elsewhere in the article. Please avoid using vertical rules and shading in table cells.

Tables
Each table should be typed, double-spaced, on a new page, and be designed to fit in one or two column(s). Vertical lines should not be used: Tables should be given a separate Arabic numbering system to the figures, and have concise headings, clearly defined subheadings and, where necessary, detailed footnotes (indicated by superscript letters). When preparing tables, using a table grid, use only one grid for each individual table and not a grid for each row. If no grid is used, use tabs, not spaces, to align columns.

References
Citation in text
Please ensure that every reference cited in the text is also present in the reference list (and vice versa). Any references cited in the abstract must be given in full. Unpublished results and personal communications are not recommended in the reference list, but may be mentioned in the text. If these references are included in the reference list they should follow the standard reference style of the journal and should include a substitution of the publication date with either 'Unpublished results' or 'Personal communication'. Citation of a reference as 'in press' implies that the item has been accepted for publication.

Reference links
Increased discoverability of research and high quality peer review are ensured by online links to the sources cited. In order to allow us to create links to abstracting and indexing services, such as Scopus, CrossRef and PubMed, please ensure that data provided in the references are correct. Please note that incorrect surnames, journal/book titles, publication year and pagination may prevent link creation. When copying references, please be careful as they may already contain errors. Use of the DOI is highly encouraged.

A DOI is guaranteed never to change, so you can use it as a permanent link to any electronic article. An example of a citation using DOI for an article not yet in an issue is: VanDecar J.C., Russo R.M., James D.E., Ambeh W.B., Franke M. (2003). Aseismic continuation of the Lesser Antilles slab beneath northeastern Venezuela. Journal of Geophysical Research, https://doi.org/10.1029/2001JB000884. Please note the format of such citations should be in the same style as all other references in the paper.

Web references
As a minimum, the full URL should be given and the date when the reference was last accessed. Any further information, if known (DOI, author names, dates, reference to a source publication, etc.), should also be given. Web references can be listed separately (e.g., after the reference list) under a different heading if desired, or can be included in the reference list.

Data references
This journal encourages you to cite underlying or relevant datasets in your manuscript by citing them in your text and including a data reference in your Reference List. Data references should include the following elements: author name(s), dataset title, data repository, version (where available), year, and global persistent identifier. Add [dataset] immediately before the reference so we can properly identify it as a data reference. The [dataset] identifier will not appear in your published article.

References in a special issue
Please ensure that the words 'this issue' are added to any references in the list (and any citations in the text) to other articles in the same Special Issue.

Reference management software
Most Elsevier journals have their reference template available in many of the most popular reference management software products. These include all products that support Citation Style Language styles, such as Mendeley. Using citation plug-ins from these products, authors only need to select the appropriate journal template when preparing their article, after which citations and bibliographies will be automatically formatted in the journal's style. If no template is yet available for this journal, please follow the format of the sample references and citations as shown in this Guide. If you use
Users of Mendeley Desktop can easily install the reference style for this journal by clicking the following link: 
http://open.mendeley.com/use-citation-style/computer-methods-and-programs-in-biomedicine

When preparing your manuscript, you will then be able to select this style using the Mendeley plug-ins for Microsoft Word or LibreOffice.

Reference formatting
There are no strict requirements on reference formatting at submission. References can be in any style or format as long as the style is consistent. Where applicable, author(s) name(s), journal title/book title, chapter title/article title, year of publication, volume number/book chapter and the article number or pagination must be present. Use of DOI is highly encouraged. The reference style used by the journal will be applied to the accepted article by Elsevier at the proof stage. Note that missing data will be highlighted at proof stage for the author to correct. If you do wish to format the references yourself they should be arranged according to the following examples:

Reference style
Text: Indicate references by number(s) in square brackets in line with the text. The actual authors can be referred to, but the reference number(s) must always be given.
Example: ‘..... as demonstrated [3,6]. Barnaby and Jones [8] obtained a different result ....’

List: Number the references (numbers in square brackets) in the list in the order in which they appear in the text.
Examples:
Reference to a journal publication:
Reference to a journal publication with an article number:
Reference to a book:
Reference to a chapter in an edited book:
Reference to a website:
Reference to a dataset:

References
Citations should be allocated Arabic numerals in order of appearance in the text. The number should be enclosed in square brackets in the text and in the reference list at the end of the text, where it should be followed by the full details according to the following examples (the 'Harvard' system is not used):


**Journal abbreviations source**

Journal names should be abbreviated according to the List of Title Word Abbreviations.

**Video**

Elsevier accepts video material and animation sequences to support and enhance your scientific research. Authors who have video or animation files that they wish to submit with their article are strongly encouraged to include links to these within the body of the article. This can be done in the same way as a figure or table by referring to the video or animation content and noting in the body text where it should be placed. All submitted files should be properly labeled so that they directly relate to the video file's content. In order to ensure that your video or animation material is directly usable, please provide the file in one of our recommended file formats with a preferred maximum size of 150 MB per file, 1 GB in total. Video and animation files supplied will be published online in the electronic version of your article in Elsevier Web products, including ScienceDirect. Please supply 'stills' with your files: you can choose any frame from the video or animation or make a separate image. These will be used instead of standard icons and will personalize the link to your video data. For more detailed instructions please visit our video instruction pages. Note: since video and animation cannot be embedded in the print version of the journal, please provide text for both the electronic and the print version for the portions of the article that refer to this content.

**Data visualization**

Include interactive data visualizations in your publication and let your readers interact and engage more closely with your research. Follow the instructions here to find out about available data visualization options and how to include them with your article.

**Supplementary material**

Supplementary material such as applications, images and sound clips, can be published with your article to enhance it. Submitted supplementary items are published exactly as they are received (Excel or PowerPoint files will appear as such online). Please submit your material together with the article and supply a concise, descriptive caption for each supplementary file. If you wish to make changes to supplementary material during any stage of the process, please make sure to provide an updated file. Do not annotate any corrections on a previous version. Please switch off the 'Track Changes' option in Microsoft Office files as these will appear in the published version.

**Research data**

This journal encourages and enables you to share data that supports your research publication where appropriate, and enables you to interlink the data with your published articles. Research data refers to the results of observations or experimentation that validate research findings. To facilitate reproducibility and data reuse, this journal also encourages you to share your software, code, models, algorithms, protocols, methods and other useful materials related to the project.

Below are a number of ways in which you can associate data with your article or make a statement about the availability of your data when submitting your manuscript. If you are sharing data in one of these ways, you are encouraged to cite the data in your manuscript and reference list. Please refer to the "References" section for more information about data citation. For more information on depositing, sharing and using research data and other relevant research materials, visit the research data page.

**Data linking**

If you have made your research data available in a data repository, you can link your article directly to the dataset. Elsevier collaborates with a number of repositories to link articles on ScienceDirect with relevant repositories, giving readers access to underlying data that gives them a better understanding of the research described.

There are different ways to link your datasets to your article. When available, you can directly link your dataset to your article by providing the relevant information in the submission system. For more information, visit the database linking page.

For supported data repositories a repository banner will automatically appear next to your published article on ScienceDirect.
In addition, you can link to relevant data or entities through identifiers within the text of your manuscript, using the following format: Database: xxxx (e.g., TAIR: AT1G01020; CCDC: 734053; PDB: 1XFN).

**Mendeley Data**
This journal supports Mendeley Data, enabling you to deposit any research data (including raw and processed data, video, code, software, algorithms, protocols, and methods) associated with your manuscript in a free-to-use, open access repository. During the submission process, after uploading your manuscript, you will have the opportunity to upload your relevant datasets directly to Mendeley Data. The datasets will be listed and directly accessible to readers next to your published article online.

For more information, visit the [Mendeley Data for journals page](https://www.mendeley.com/data-for-journals/).

**Data statement**
To foster transparency, we encourage you to state the availability of your data in your submission. This may be a requirement of your funding body or institution. If your data is unavailable to access or unsuitable to post, you will have the opportunity to indicate why during the submission process, for example by stating that the research data is confidential. The statement will appear with your published article on ScienceDirect. For more information, visit the [Data Statement page](https://www.elsevier.com/authors/downloads/data-statement).

**AFTER ACCEPTANCE**

**Online proof correction**
Corresponding authors will receive an e-mail with a link to our online proofing system, allowing annotation and correction of proofs online. The environment is similar to MS Word: in addition to editing text, you can also comment on figures/tables and answer questions from the Copy Editor. Web-based proofing provides a faster and less error-prone process by allowing you to directly type your corrections, eliminating the potential introduction of errors.

If preferred, you can still choose to annotate and upload your edits on the PDF version. All instructions for proofing will be given in the e-mail we send to authors, including alternative methods to the online version and PDF.

We will do everything possible to get your article published quickly and accurately. Please use this proof only for checking the typesetting, editing, completeness and correctness of the text, tables and figures. Significant changes to the article as accepted for publication will only be considered at this stage with permission from the Editor. It is important to ensure that all corrections are sent back to us in one communication. Please check carefully before replying, as inclusion of any subsequent corrections cannot be guaranteed. Proofreading is solely your responsibility.

**Offprints**
The corresponding author will, at no cost, receive a customized Share Link providing 50 days free access to the final published version of the article on ScienceDirect. The Share Link can be used for sharing the article via any communication channel, including email and social media. For an extra charge, paper offprints can be ordered via the offprint order form which is sent once the article is accepted for publication. Both corresponding and co-authors may order offprints at any time via Elsevier's [Author Services](https://www.elsevier.com/author-services). Corresponding authors who have published their article gold open access do not receive a Share Link as their final published version of the article is available open access on ScienceDirect and can be shared through the article DOI link.

**AUTHOR INQUIRIES**
Visit the Elsevier Support Center to find the answers you need. Here you will find everything from Frequently Asked Questions to ways to get in touch.

You can also check the status of your submitted article or find out when your accepted article will be published.

© Copyright 2018 Elsevier | https://www.elsevier.com