DESCRIPTION

*Precision Engineering - Journal of the International Societies for Precision Engineering and Nanotechnology* is devoted to the multidisciplinary study and practice of high accuracy engineering, metrology, and manufacturing. The journal takes an integrated approach to all subjects related to research, design, manufacture, performance validation, and application of high precision machines, instruments, and components, including fundamental and applied research and development in manufacturing processes, fabrication technology, and advanced measurement science. The scope includes precision-engineered systems and supporting metrology over the full range of length scales, from atom-based nanotechnology and advanced lithographic technology to large-scale systems, including optical and radio telescopes and macrometrology.

*Precision Engineering* was first published in January 1979; since 1986 it has also been known to many of its readers as the Journal of the American Society of Precision Engineering. Now, with effect from January 2000, it assumes a new look, proudly proclaiming itself the Journal of the International Societies for Precision Engineering and Nanotechnology.

In addition to its continuing association with the American Society of Precision Engineering (ASPE), the journal is now associated with two further bodies: the newly established European Society for Precision Engineering and Nanotechnology (EUSPEN) and the Japan Society for Precision Engineering (JSPE), founded in 1933.

For more information about each of these three societies, please visit their home pages:

**ASPE:** [http://www.aspe.net](http://www.aspe.net)
**euspenn:** [http://www.euspen.org](http://www.euspen.org)
**JSPE:** [http://www.jspe.or.jp](http://www.jspe.or.jp)

AUDIENCE

For research and development workers, designers, and engineers in industry, institutions, and the academic world.

IMPACT FACTOR

2018: 2.685 © Clarivate Analytics Journal Citation Reports 2019
ABSTRACTING AND INDEXING

Scopus

EDITORIAL BOARD

Editors-in-Chief
S.J. Ludwick, Aerotech Inc, Pittsburgh, Pennsylvania, United States
R.K. Leach, University of Nottingham, Nottingham NG7 2RD, United Kingdom
M. Kunieda, The University of Tokyo, Bunkyo-Ku, Tokyo, Japan

Associate Editors
G. Aguirre, Ideko Technological Centre, 20870, Elgoibar, Spain
A. Archenti, KTH Royal Institute of Technology Department of Production Engineering, 114 28, Stockholm, Sweden
P.B. Bills, University of Huddersfield School of Computing and Engineering, HD1 3DH, Huddersfield, United Kingdom
G. Bissacco, Technical University of Denmark, 2800, Kongens(Kgs) Lyngby, Denmark
N. Bosmans, KU Leuven Association, 3000, Leuven, Belgium
D.M. Brouwer, Faculty of Engineering Technology (CTW), University of Twente, 7500 AE Enschede, The Netherlands
B. Cheung, Hong Kong Polytechnic University Department of Industrial and Systems Engineering, Kowloon, Hong Kong
A.T. Clare, University of Nottingham, Nottingham NG72RD, United Kingdom
M. Cullinan, University of Texas at Austin, Austin, Texas, 78712-1139, United States
F. Fang, Tianjin University State Key Laboratory of Precision Measuring Technology and Instruments
J. Fox, National Institute of Standards and Technology, Gaithersburg, Maryland, MD 20899, United States
K. Furutani, Toyota Technological Institute at Chicago, 468-8511, Nagoya, Aichi, Japan
H. Haitjema, Mitutoyo Research Center Europe BV, 3905 KW, Veenendaal, The Netherlands
M. Holmes, Zygo Corp, Middlefield, Connecticut, 06455-1291, United States
T. Matsumura, Tokyo Denki University, 101-8457, Chiyoda-Ku, Japan
J.M. Mayr, Swiss Federal Institute of Technology, 8092, Zurich, Switzerland
C. Morgan, Moore Nanotechnology Systems LLC, Swanzey, New Hampshire, 03446, United States
B. Muralikrishnan, National Institute of Standards and Technology, Gaithersburg, MD 20899, United States
W. Natsu, Tokyo University of Agriculture and Technology, 183-8538, Fuchu, Japan
C. Okwudire, University of Michigan Department of Mechanical Engineering, Ann Arbor, Michigan, 48109-2125, United States
Y.E. Otani, Utsunomiya University Center for Optical Research and Education, Tochigi 321-8585, Japan
T. Senba, Fukuoka Institute of Technology, Dept. of Intelligent Mechanical Engineering, 811-0295 Fukuoka, Japan
C. Tyler, Boeing, Berkeley, MO 63143, United States
N.W. Weston, Renishaw Plc, GL12 8JR, Wotton-Under-Edge, United Kingdom
H. Wu, Intel Corp, Chandler, OR 97124, United States
L. Zhou, Ibaraki University College of Engineering, Nakanarusawa 4-12-1 Hitachi, Ibaragi Prefecture, Japan
INTRODUCTION

Precision Engineering - Journal of the International Societies for Precision Engineering and Nanotechnology is devoted to the multidisciplinary study and practice of high accuracy engineering, metrology, and manufacturing. The journal takes an integrated approach to all subjects related to research, design, manufacture, performance validation, and application of high precision machines, instruments, and components, including fundamental and applied research and development in manufacturing processes, fabrication technology, and advanced measurement science. The scope includes precision-engineered systems and supporting metrology over the full range of length scales, from atom-based nanotechnology and advanced lithographic technology to large-scale systems, including optical and radio telescopes and macrometrology.

Precision Engineering was first published in January 1979; since 1986 it has also been known to many of its readers as the Journal of the American Society of Precision Engineering. Now, with effect from January 2000, it assumes a new look, proudly proclaiming itself the Journal of the International Societies for Precision Engineering and Nanotechnology.

In addition to its continuing association with the American Society for Precision Engineering (ASPE), the journal is now associated with two further bodies: the newly established European Society for Precision Engineering and Nanotechnology (EUSPEN) and the Japan Society for Precision Engineering (JSPE), founded in 1933.

For more information about each of these three societies, please visit their home pages:
ASPE: http://www.aspe.net
EUSPEN: http://www.euspen.org
JSPE: http://www.jspe.or.jp

Types of Paper

Original research papers, reviews, short communications, letters, letters to the editor, news items, calendar inserts.

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
BEFORE YOU BEGIN

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

Declaration of interest
All authors must disclose any financial and personal relationships with other people or organizations 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. Authors should complete the declaration of interest statement using this template and upload to the submission system at the Attach/Upload Files step. If there are no interests to declare, please choose: 'Declarations of interest: none' in the template. This statement will be published within the article if accepted. More information.

Submission declaration and verification
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. To verify originality, your article may be checked by the originality detection service Crossref Similarity Check.

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 preprint 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.

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.

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 (CC BY)
Lets others distribute and copy the article, create extracts, abstracts, and other revised versions, adaptations or derivative works of or from an article (such as a translation), include in a collective work (such as an anthology), text or data mine the article, even for commercial purposes, as long as they credit the author(s), do not represent the author as endorsing their adaptation of the article, and do not modify the article in such a way as to damage the author's honor or reputation.

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.

The gold open access publication fee for this journal is USD 2500, excluding taxes. Learn more about Elsevier's pricing policy: 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](https://www.elsevier.com/locate/precision) 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 citeable form. Find out more.

This journal has an embargo period of 24 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.

**Submission**

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 source files to a single PDF file of the article, which is used in the peer-review process. Please note that even though manuscript source files are converted to PDF files at submission for the review process, these source files are needed for further processing after acceptance. All correspondence, including notification of the Editor’s decision and requests for revision, takes place by e-mail removing the need for a paper trail.

Submit your article

Please submit your article via [https://www.evise.com/profile/api/navigate/PRE](https://www.evise.com/profile/api/navigate/PRE)

**Additional information**

**Corresponding author:** Clearly indicate who is responsible for correspondence at all stages of refereeing and publication, including post-publication. Ensure that telephone and fax numbers (with country and area code) are provided in addition to the e-mail address and the complete postal address. Full postal addresses must be given for all co-authors. Please consult a recent journal paper for style if possible.

**Original material:** Submission of an article implies that the work described has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, without the written consent of the Publisher.

**PREPARATION**

**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.

**Use of word processing software**

It is important that the file be saved in the native format of the word processor used. The text should be in single-column format. Keep the layout of the text as simple as possible. Most formatting codes will be removed and replaced on processing the article. In particular, do not use the word processor's options to justify text or to hyphenate words. However, do use bold face, italics, subscripts, superscripts etc. When preparing tables, if you are 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. The electronic text should be prepared in a way very similar to that of conventional manuscripts (see also the Guide to Publishing with Elsevier). Note that source files of figures, tables and text graphics will be required whether or not you embed your figures in the text. 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.

**LaTeX**

You are recommended to use the latest Elsevier article class to prepare your manuscript and BibTeX to generate your bibliography.

Our Guidelines has full details.

**Article Structure**

**General:**
Editors reserve the right to adjust style to certain standards of uniformity. Original manuscripts are discarded one month after publication unless the Publisher is asked to return original material after use. An electronic copy of the manuscript on disk should accompany the final accepted version. Please use Word, Word Perfect or LaTeX files for the text of your manuscript. (For further information about LaTeX submission, please go to https://www.elsevier.com/latex.)

**Structure:**
Follow this order when typing manuscripts: Title (an abbreviated title of less than 40 characters [including spaces] should also be suggested), Authors, Affiliations, Abstract, Keywords, Main text, Acknowledgements, Appendix, References, Figure Captions and then Tables. For submission in hardcopy, do not import figures into the text - see Illustrations. Collate acknowledgements in a separate section at the end of the article and do not include them on the title page, as a footnote to the title or otherwise.

**Text Layout:**
Use double spacing and wide (3 cm) margins. (Avoid full justification, i.e., do not use a constant right-hand margin.) Ensure that each new paragraph is clearly indicated. Present tables and figure legends on separate pages at the end of the manuscript. If possible, consult a recent issue of the journal to become familiar with layout and conventions. Number all pages consecutively, use 12 or 10 pt font size and standard fonts. Print the entire manuscript on one side of the paper only.

**Corresponding author:**
Clearly indicate who is responsible for correspondence at all stages of refereeing and publication, including post-publication. Ensure that telephone and fax numbers (with country and area code) are provided in addition to the e-mail address and the complete postal address. Full postal addresses must be given for all co-authors. Please consult a recent journal paper for style if possible. Symbols: Mathematical symbols and formulae should be typed. Particular care should be exercised in identifying all symbols and in avoiding ambiguities. Distinction should be made between the number one (1) and the letter l and between zero (0) and the letter O.

**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.

**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 lower-
case 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.

**Highlights**

Highlights are mandatory for this journal as they help 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).

**Abstract**

A self-contained abstract outlining in a single paragraph the aims, scope and conclusions of the paper must be supplied.

**Graphical abstract**

Although a graphical abstract is optional, its use is encouraged as it draws more attention to the online article. The graphical abstract should summarize the contents of the article in a concise, pictorial form designed to capture the attention of a wide readership. Graphical abstracts should be submitted as a separate file in the online submission system. Image size: Please provide an image with a minimum of $531 \times 1328$ pixels ($h \times w$) or proportionally more. The image should be readable at a size of $5 \times 13$ cm using a regular screen resolution of 96 dpi. Preferred file types: TIFF, EPS, PDF or MS Office files. You can view Example Graphical Abstracts on our information site. Authors can make use of Elsevier’s Illustration Services to ensure the best presentation of their images and in accordance with all technical requirements.

**Keywords**

Immediately after the abstract, please provide keywords (avoid, for example, 'and', 'of'). Be sparing with abbreviations: only abbreviations firmly established in the field may be eligible.

**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.

**Units**

Follow internationally accepted rules and conventions: use the international system of units (SI). Engineering equivalents may be given in brackets afterwards.
**Math formulae**
Vectors and tensors should be marked clearly on the manuscript. Equation numbers should appear in parenthesis and be numbered consecutively. All equation numbers must appear on the right-hand side of the equation and should be referred to within the text. Use the following sequence of parentheses:*).}

**Artwork**

*Electronic artwork*

**General points**
- Make sure you use uniform lettering and sizing of your original artwork.
- Embed the used fonts if the application provides that option.
- Aim to use the following fonts in your illustrations: Arial, Courier, Times New Roman, Symbol, or use fonts that look similar.
- Number the illustrations according to their sequence in the text.
- Use a logical naming convention for your artwork files.
- Provide captions to illustrations separately.
- Size the illustrations close to the desired dimensions of the published version.
- Submit each illustration as a separate file.
- Ensure that color images are accessible to all, including those with impaired color vision.

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**

If your electronic artwork is created in a Microsoft Office application (Word, PowerPoint, Excel) then please supply 'as is' in the native document format.

Regardless of the application used other than Microsoft Office, 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 all used fonts.
- TIFF (or JPEG): Color or grayscale photographs (halftones), keep to a minimum of 300 dpi.
- TIFF (or JPEG): Bitmapped (pure black & white pixels) line drawings, keep to a minimum of 1000 dpi.
- TIFF (or JPEG): Combinations bitmapped line/half-tone (color or grayscale), keep to a minimum of 500 dpi.

**Please do not:**
- Supply files that are optimized for screen use (e.g., GIF, BMP, PICT, WPG); these typically have a low number of pixels and limited set of colors;
- Supply files that are too low in resolution;
- Submit graphics that are disproportionately large for the content.

**Color artwork**

Please make sure that artwork files are in an acceptable format (TIFF, EPS 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 on the Web (e.g., ScienceDirect and other sites) regardless of whether or not these illustrations are reproduced in color in the printed version. For color reproduction in print, you will receive information regarding the costs from Elsevier after receipt of your accepted article. Please indicate your preference for color in print or on the Web only. For further information on the preparation of electronic artwork, please see https://www.elsevier.com/artworkinstructions.

Please note: Because of technical complications which can arise by converting color figures to "gray scale" (for the printed version should you not opt for color in print) please submit in addition usable black and white versions of all the color illustrations.

**Figure captions**

Ensure that each illustration has a caption. Supply captions separately, not attached to the figure. 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.
References

Citation in text
All publications cited in the text should be presented in a list of references following the text of the manuscript. In the text make references using a number in square brackets on the line (e.g. "Since Peterson [1] has shown?") and the full reference should be given in a numerical list at the end of the paper.

References should be given in the following form:

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.

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 reference management software, please ensure that you remove all field codes before submitting the electronic manuscript. More information on how to remove field codes from different reference management software.

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

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.
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:
Note shortened form for last page number. e.g., 51–9, and that for more than 6 authors the first 6 should be listed followed by 'et al.' For further details you are referred to 'Uniform Requirements for Manuscripts submitted to Biomedical Journals' (J Am Med Assoc 1997;277:927–34) (see also Samples of Formatted References).

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.

Data in Brief
You have the option of converting any or all parts of your supplementary or additional raw data into one or multiple data articles, a new kind of article that houses and describes your data. Data articles ensure that your data is actively reviewed, curated, formatted, indexed, given a DOI and publicly available to all upon publication. You are encouraged to submit your article for Data in Brief as an additional item directly alongside the revised version of your manuscript. If your research article is accepted, your data article will automatically be transferred over to Data in Brief where it will be editorially reviewed and published in the open access data journal, Data in Brief. Please note an open access fee of 600 USD is payable for publication in Data in Brief. Full details can be found on the Data in Brief website. Please use this template to write your Data in Brief.

MethodsX
You have the option of converting relevant protocols and methods into one or multiple MethodsX articles, a new kind of article that describes the details of customized research methods. Many researchers spend a significant amount of time on developing methods to fit their specific needs or setting, but often without getting credit for this part of their work. MethodsX, an open access journal, now publishes this information in order to make it searchable, peer reviewed, citable and reproducible. Authors are encouraged to submit their MethodsX article as an additional item directly alongside the revised version of their manuscript. If your research article is accepted, your methods article will automatically be transferred over to MethodsX where it will be editorially reviewed. Please note an open access fee is payable for publication in MethodsX. Full details can be found on the MethodsX website. Please use this template to prepare your MethodsX article.

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.

Additional information
Figures:
Please note: Authors are strongly encouraged (optional) to include embedded figures (with figure captions) and tables directly in the body of the manuscript to facilitate the review of the paper. However, you are still required to upload the figure file(s) as separate file(s) from the main manuscript (either individually or all in one separate file). If you do not, your manuscript will be returned to you to upload a separate figure file/files. Elsevier's preferred file formats are EPS, TIFF and PDF. MS Office file formats are only allowed under certain conditions. For figure guidelines, please review the information available here: https://www.elsevier.com/authors/author-schemas/artwork-and-media-instructions

Tables:
Tables should be numbered consecutively and given suitable captions and each table should begin on a new page. No vertical rules should be used. Tables should not duplicate results presented elsewhere in the manuscript (for example, in graphs). Footnotes to tables should be typed below the table and should be referred to by superscript lowercase letters.

Authors will be notified of the acceptance of their paper by the editor. The Publisher will also send a notification of receipt of the paper in production.

**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**. 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.

**Additional information**

Author Benefits:

Author discount: Contributors to Elsevier journals are entitled to a 30% discount on all Elsevier books. See [https://www.elsevier.com/homepage/booksbutler](https://www.elsevier.com/homepage/booksbutler) for more information.

Online Paper Tracking:

Authors can track the status of their accepted paper online at [https://www.elsevier.com/trackarticle](https://www.elsevier.com/trackarticle) using the reference supplied by the Publisher.

**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](https://www.elsevier.com)