

Creating Figures for Scientific Journals

Naoya Kawakami

May 21, 2025
version 1.0

1 Introduction

To publish high-quality figures, it's crucial to carefully manage the process of preparing the figures. Otherwise, the quality of figures may unintentionally degrade during the process. However, excessively high quality can result in large file sizes. Therefore, it's important to produce figures with appropriate quality for the intended purpose. This document provides a summary of the figure preparation process, including the image formats, resolution, and quality.

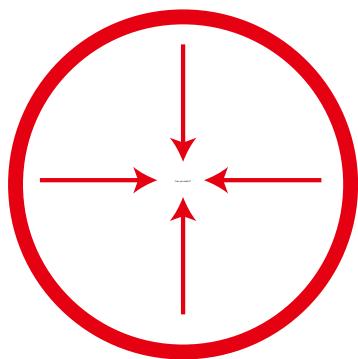
2 Raster and Vector images

There are many image formats, but they can be broadly categorized into two types: raster and vector images.

- **Raster images:** Raster images are composed of pixels, which are small dots of color. The quality of raster images is determined by the number of pixels per inch (PPI) or dots per inch (DPI). The higher the PPI or DPI, the more detail the image can display. However, increasing the PPI or DPI also increases the file size. JPG, PNG, and TIFF are common raster image formats.
- **Vector images:** Vector images are composed of lines and curves, which are defined by mathematical expressions. This means that vector images can be scaled to any size without losing quality. PDF is a common vector image format.

The main difference between raster and vector images is how they are created and displayed. Raster images are made up of pixels, while vector images are made up of lines and curves. This means that raster images can lose quality when scaled, while vector images can be scaled without losing quality. You can see the difference in Figure 1. The left side is a vector image (PDF) and the right side is a raster image (PNG), with almost the same file size (70 KB). Try magnifying the image. You may see that the edge of the object is sharp in the vector image, while it is bulged in the raster image. Furthermore, you may realize that the small sentence at the center of the circle is clearly visible in the vector image, while it is unclear in the raster image. These differences come from how the images are displayed: when scaled, the vector images are reconstructed based on their

(a) Vector image



(b) Raster image

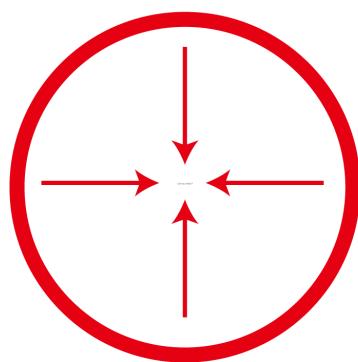


Figure 1: (a) Vector image (PDF), prepared by Illustrator without compression. The file size is 70 KB. (b) Raster image (PNG) with 300 dpi, prepared by Illustrator. The file size is 64 KB

mathematical expression, but the raster images are not. Therefore, for preparing high-quality images, it is recommended to use vector images whenever possible. You should note that the image format can be unintentionally changed during the handling of images, such as when copying, pasting, and recording. For example, even if you copy the image from the PDF, it is converted to a raster-type image when pasting it into PowerPoint. Once the image is converted to raster type, the image quality is limited by the pixels, and further handling may degrade the quality. If you need to use raster images, use a high PPI or DPI to ensure the quality is maintained by checking the settings of the software.

3 Software for preparing figures

In this section, I will introduce the properties of the software used to prepare the figures.

3.1 PowerPoint

We often use PowerPoint for presentations, so it is convenient to prepare figures. The function of PowerPoint is enough to prepare simple figures. You can also insert images and graphs from other software. However, preparing high-quality images is difficult, as handling vector images is not straightforward in PowerPoint¹. Even if you prepared a vector image from another software, it is converted to a raster image when pasted into PowerPoint. Furthermore, copying and pasting the images from the PowerPoint to other software, such as Word, may lead to further quality degradation. Therefore, preparing the figures for the publication using PowerPoint is not recommended.

¹According to several websites, it seems possible. Search for it if you are interested in it.

3.2 Illustrator

Illustrator can handle vector formats directly, allowing PDF images to be imported while maintaining their vector format. By exporting in vector format, the original diagram retains its vector quality. Therefore, I always use Illustrator for preparing high-quality images.

4 Software for preparing documents

The figures are combined with the text in the document. Therefore, we will introduce the characteristics of the software used to prepare the documents.

4.1 Word

Word is a very conventional documentation software. It is easy to handle the images, such as drag and drop. Furthermore, the history of revision can be recorded, so it is suitable for collaborative work. In addition, many supporting functions for writing are available, such as spell check and grammar check. However, Word is not suitable for keeping high-quality figures. When pasting images, the quality of the images is degraded, especially when using the initial setting. Furthermore, the image quality is degraded when converting the Word file to a PDF file.

4.2 LaTeX

LaTeX is a document preparation software². It allows users to define text formats and arrange figures by preparing a source file, which is then converted into a document. Although not intuitive, LaTeX is favored for its ability to create sophisticated documents, especially those containing mathematical formulas. It also supports directly importing vector images, making it ideal for producing high-quality PDFs. However, it requires an initial setup and lacks some assistive features in Word.

5 How do I prepare figures?

Basically, I prepare the figures using Illustrator. When preparing the figures in the other software (such as Igor for plotting), output them in PDF format and import them into Illustrator. If the PDF format is not available, I use high-resolution raster format (PNG or TIFF). In Illustrator, the schematic figures are prepared, figures are arranged, and text boxes, arrows, annotations, and other elements are added. Then, the figures are exported in various formats depending on the purpose or the documenting software.

When preparing the documents with high-quality figures by myself, I use LaTeX and export the figures in PDF format from Illustrator. Figure 2 shows the setting of the Illustrator for exporting the figures³. The export of the figures is done by selecting "Export → Export As" from the File menu, as shown in Fig. 2(a). The export setting for exporting

²This document is prepared by LaTeX

³Sorry, it is in Japanese.

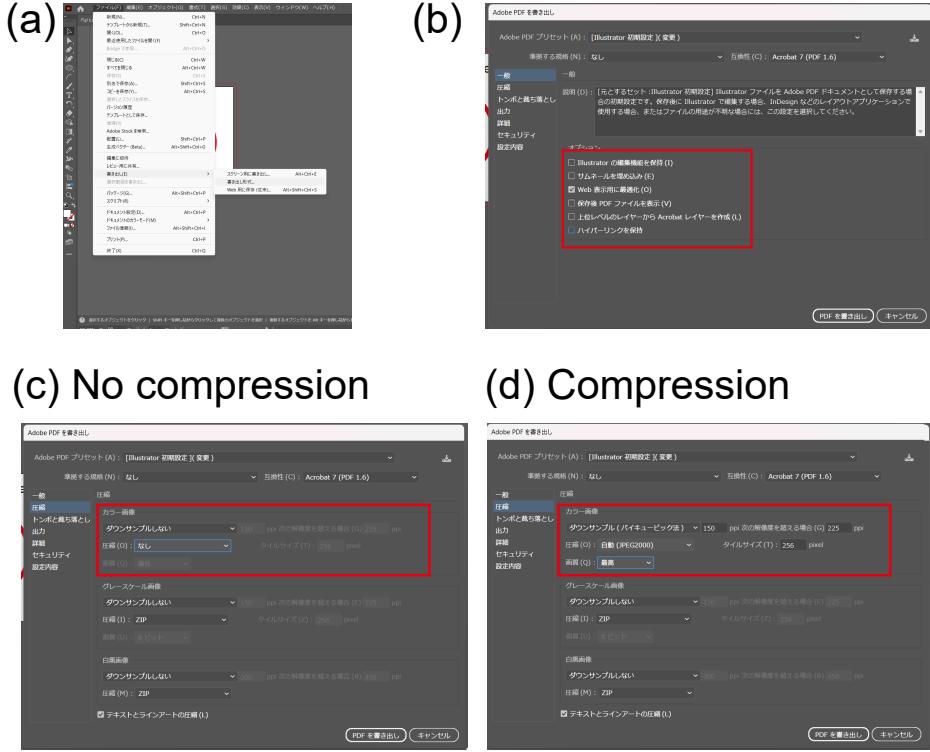


Figure 2

as PDF is shown in Fig. 2(b) to (d). I first uncheck the options except for "Optimize for Fast Web View". This option is useful for reducing the file size. Then, open the "Compress" tab. For the highest quality figures, I set the "No downsample" and "No compression", as shown in Fig. 2(c). Sometimes, the figure quality is excessively high, and the file size becomes too large. In that case, I set the "Downsample (bicubic method)" and "Compression" to JPEG, as shown in Fig. 2(d).

When preparing the papers, I use Word, and the figures are exported in PNG format. The PNG figures are attached to the Word document for collaborators to review. In many journals, the figures are requested to be submitted separately from the main text, so I prepare the high-quality PDF figures at this stage.