VOSviewer Manual

Nees Jan van Eck and Ludo Waltman

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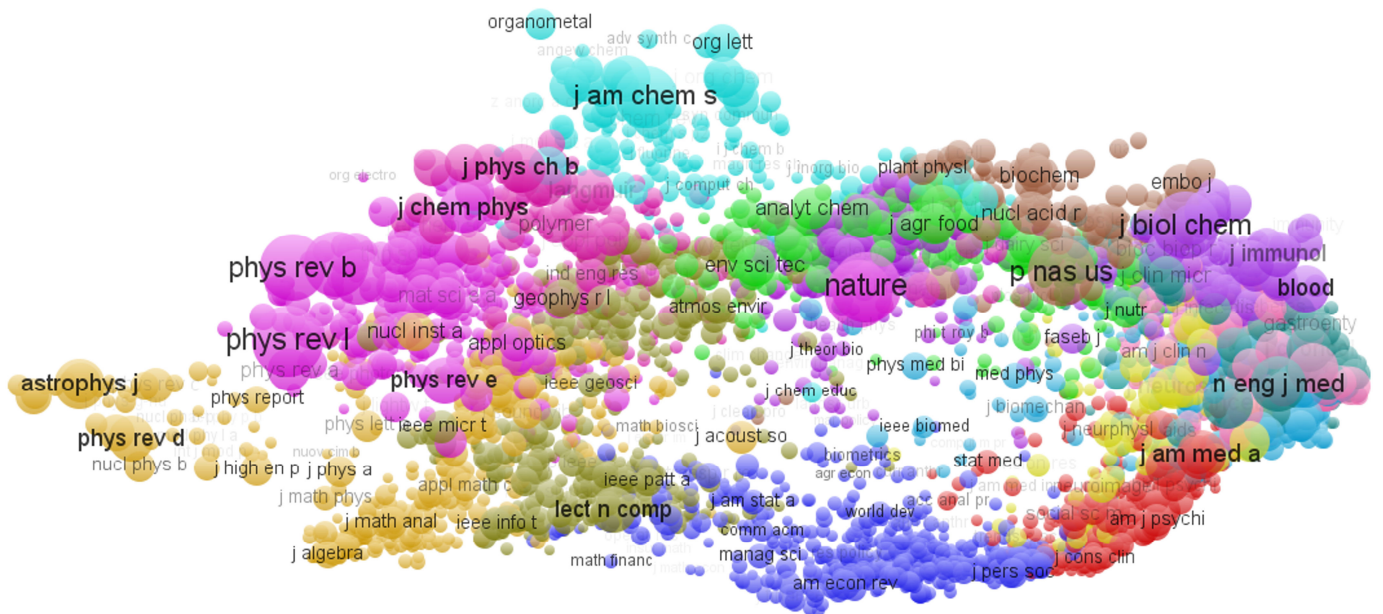
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1 Introduction

VOSviewer is a computer program that can be used for the following purposes:

- VOSviewer can be used to construct a map based on a co-occurrence matrix. Maps are constructed using the VOS mapping technique (Van Eck and Waltman, 2009a, 2009b).

- VOSviewer can be used to view a map. It can show a map in various different ways, each emphasizing a different aspect of the map. It offers functionality such as zooming, scrolling, and searching, which facilitates the detailed examination of a map. The viewing capabilities of VOSviewer are especially useful when working with maps containing at least a moderately large number of items (e.g., at least 100 or 200 items).

To view a map using VOSviewer, it is not necessary that the map has also been constructed using VOSviewer. The map may have been constructed using another computer program. VOSviewer can for example be used to view maps that have been constructed using a multidimensional scaling program such as the PROXSCAL program in SPSS.

VOSviewer is primarily intended to be used for bibliometric analyses. It can for example be used to construct maps of authors or journals based on co-citation data or to construct maps of keywords based on co-occurrence data. However, VOSviewer can also be used for non-bibliometric analyses that rely on co-occurrence data.

VOSviewer can be obtained from the web site www.vosviewer.com. The program can be used freely. (Commercial use is also allowed.)

In this manual, we are concerned with version 1.0.2 of VOSviewer. We provide an overview of the functionality of VOSviewer in Section 2, and we discuss the file types used by VOSviewer in Section 3. For additional information about VOSviewer, we refer to a paper that we have written (Van Eck and Waltman, 2009a, 2009b). In this paper, we provide a general introduction to VOSviewer and we describe in considerable detail the technical implementation of specific parts of the program.

2 Overview

In this section, we provide an overview of the functionality of VOSviewer. We begin by discussing the **Open Map** dialog box. This dialog box, which is shown in Figure 1, appears when VOSviewer is started. There are two ways to open a map using the **Open Map** dialog box. Which way to choose depends on one's purpose:

- If one's purpose is both to construct a map and to view it, one has to provide the names of an items file and a co-occurrences file. The items file contains the labels of the items in the map, and it may also contain descriptions and colors of items. The co-occurrences file contains the co-occurrence matrix based on which the map will be constructed. We note that, after the map has been constructed, the co-occurrence matrix will be kept in memory for possible future use.

- If one already has a map and one's purpose is to view the map, one has to provide the names of an items file and a coordinates file. The items file contains the labels of the items in the map, and it may also contain descriptions and colors of items. The coordinates file contains the coordinates and possibly also the weights of the items in the map. By the weight of an item, we mean the total number of occurrences or co-occurrences of the item.

We note that the **...** buttons in the **Open Map** dialog box can be used to browse for a file. Another thing to note is that if no name of an items file is provided items will be labeled automatically (*item 1*, *item 2*, etc). For a detailed discussion of the various file types, we refer to Section 3.
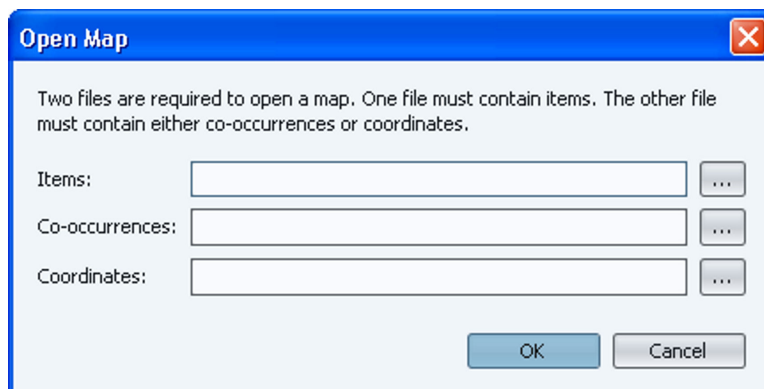

Figure 1. The Open Map dialog box.

After opening a map, one arrives in the main window of VOSviewer. This window is shown in Figure 2.[1] As can be seen in the figure, the main window of VOSviewer consists of the following four panels:

- *Main panel*. In this panel, a selected area of the currently active map is shown. VOSviewer has zoom and scroll functionality that can be used to determine which area of the currently active map is shown in the main panel.
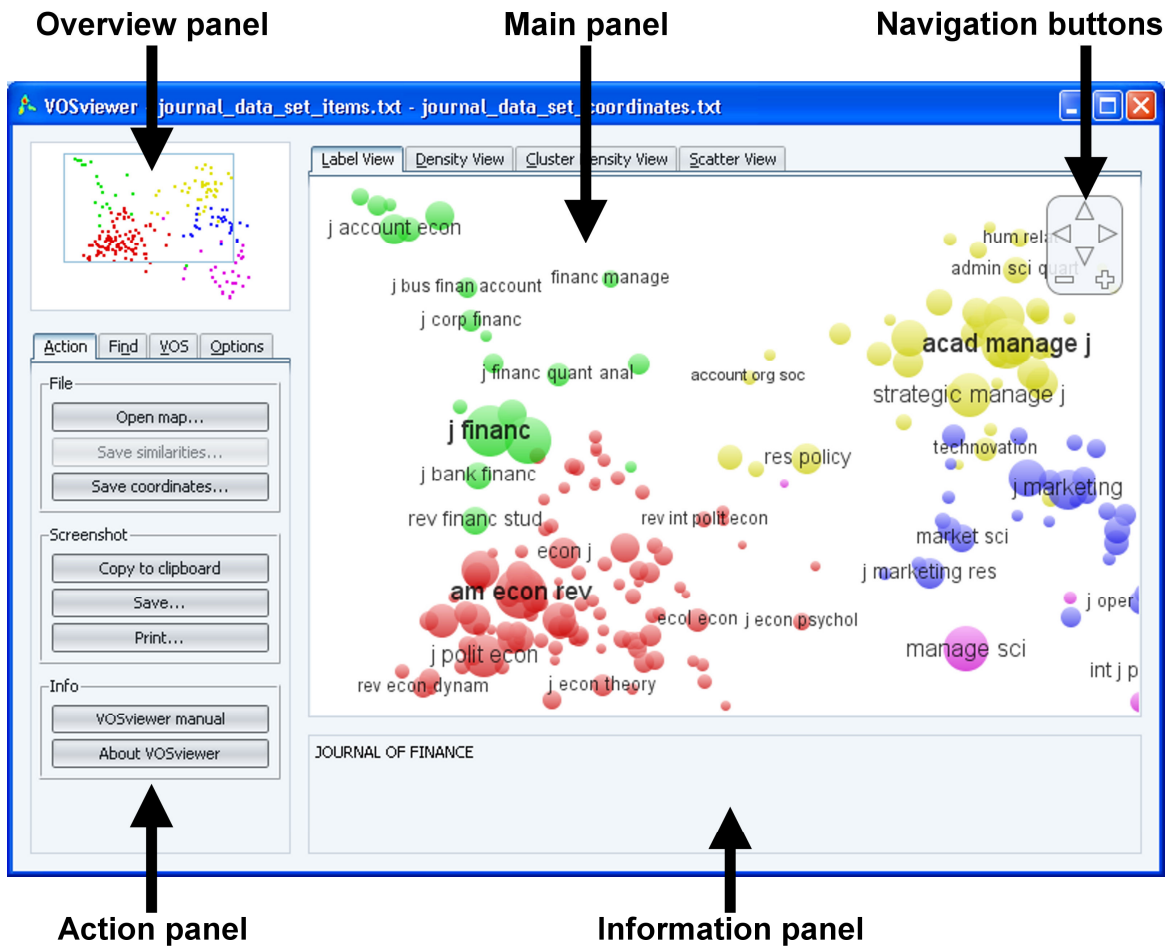

Figure 2. The main window of VOSviewer.

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[1] To reproduce Figure 2, use the items file `journal_data_set_items.txt` and the co-occurrences file `journal_data_set_cooccurrences.txt`. These files are distributed together with VOSviewer. They can also be used to reproduce other figures in this section. We refer to Van Eck and Waltman (2009a, 2009b) for a brief discussion of the data set.

- *Overview panel*. In this panel, an overview of the currently active map is shown. A rectangular frame is displayed in the overview panel to indicate which area of the currently active map is shown in the main panel.

- *Action panel*. This panel can be used to undertake various actions, such as opening a map, making a screenshot, searching for an item, running the VOS mapping technique, and changing settings.

- *Information panel*. In this panel, information about one of the items in the currently active map can be displayed.

In the next subsections, we discuss each of the panels in more detail.

2.1 Main panel

As can be seen in Figure 2, the main panel of VOSviewer is used to show a selected area of the currently active map. The zoom and scroll functionality of VOSviewer can be used to determine which area of the currently active map is shown. Depending on the available data, the main panel consists of three or four tabs. Each tab provides a different view on the currently active map. We now discuss each of the tabs:

- **Label View**. In the label view, items are indicated by their label and, by default, also by a circle. For each item, the font size of the item's label and the size of the item's circle depend on the weight of the item. If colors have been assigned to items, each item's circle is displayed in the color of the item. By default, to avoid overlapping labels, only a subset of all labels is visible. The label view is particularly useful for a detailed examination of a map. An example of the label view is shown in Figure 3.

- **Density View**. In the density view, items are indicated by their label in a similar way as in the label view. Each point in a map has a color that depends on the density of items at that point. By default, this color is somewhere in between red and blue. The larger the number of items in the neighborhood of a point and the higher the weights of the items, the closer the color of the point is to red. Conversely, the smaller the number of items in the neighborhood of a point and the lower the weights of the items, the closer the color of the point is to blue. The density view is particularly useful to get an overview of the important areas of a map. We refer to Van Eck and Waltman (2009a, 2009b) for a detailed description of the technical implementation of the density view. An example of the density view is shown in Figure 4.

- **Cluster Density View**. The cluster density view is available only if clusters have been specified in the items file (see Subsection 3.1). Each item then belongs to a cluster. The cluster density view is similar to the ordinary density view except that the density of items is displayed separately for each cluster of items. In the cluster density view, the color of a point in a map is close to the color of a certain cluster if there are a large number of items belonging to that cluster in the neighborhood of the point. Like in the ordinary density view, items with high weights count more heavily than items with low weights. The cluster density view is particularly useful to get an overview, for each cluster separately, of the important areas of a map. We refer to Van Eck and Waltman (2009a, 2009b) for a detailed description of the technical implementation of the cluster density view. An example of the cluster density view is shown in Figure 5.

- **Scatter View**. In the scatter view, items are indicated by a small circle. If colors have been assigned to items, each item's circle is displayed in the color of the item. No labels are displayed. The scatter view is particularly useful to get an overview of the general structure of a map. The way in which a map is shown in the scatter view is similar to the way in which a map is shown in the overview panel discussed below. An example of the scatter view is shown in Figure 6.

To facilitate the detailed examination of a map, VOSviewer offers zoom and scroll functionality. In the main panel, zooming and scrolling can be done in the following three ways:

- *Using the mouse*. To zoom in, move the mouse upwards while keeping the right mouse button pressed. Conversely, to zoom out, move the mouse downwards while keeping the right mouse button pressed. As an alternative, one can also use the mouse wheel to zoom in and out. To scroll through a map, move the mouse while keeping the left mouse button pressed.

- *Using the navigation buttons in the upper right corner of the main panel (see Figure 2)*. Use the plus and minus buttons to zoom in and out. Use the arrow buttons to scroll through a map.

- *Using the keyboard*. Use the plus and minus keys to zoom in and out. Use the arrow keys to scroll through a map.
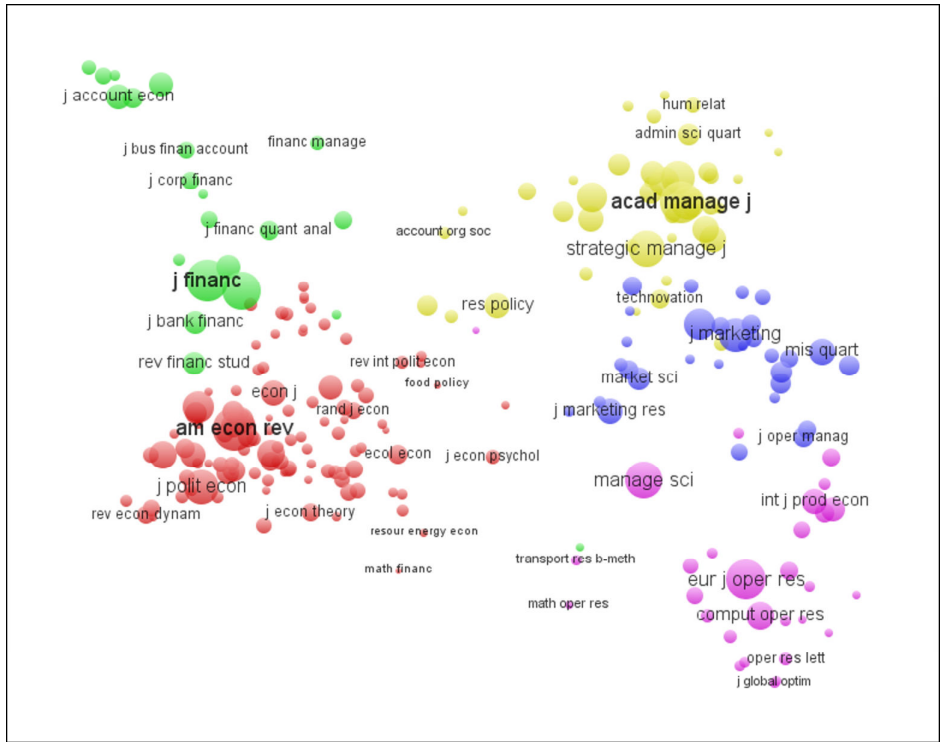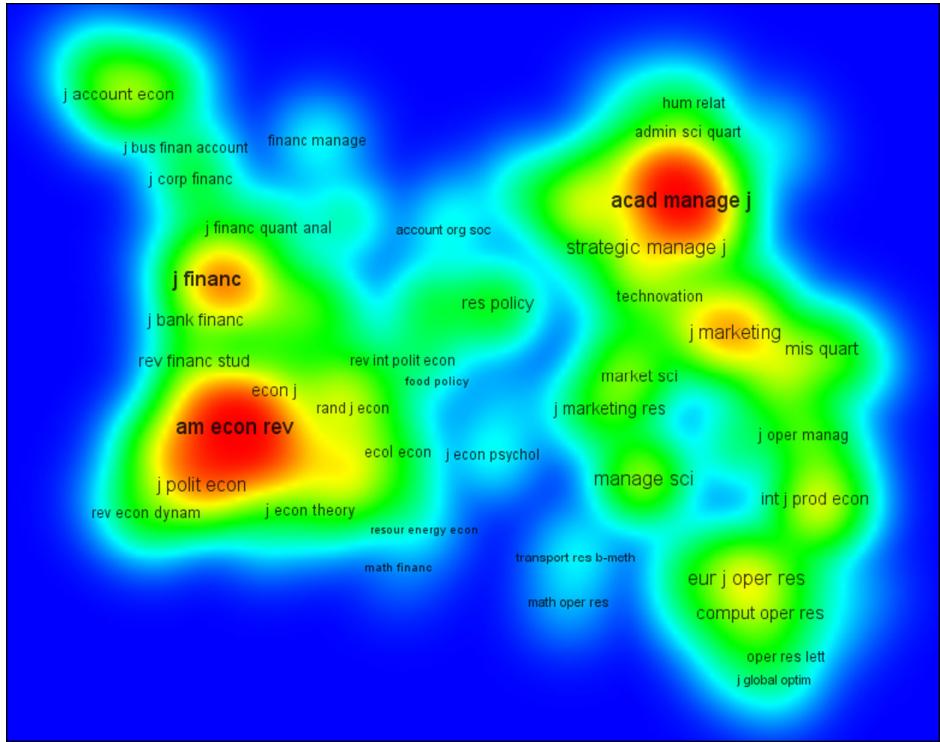
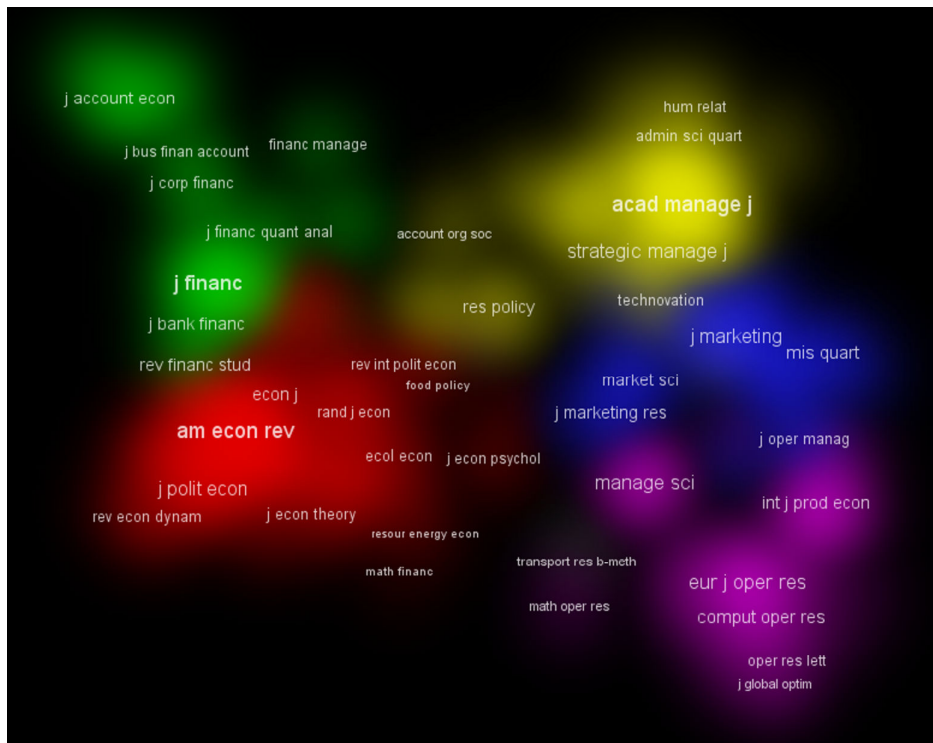**Figure 3. The label view.**

Figure 4. The density view.

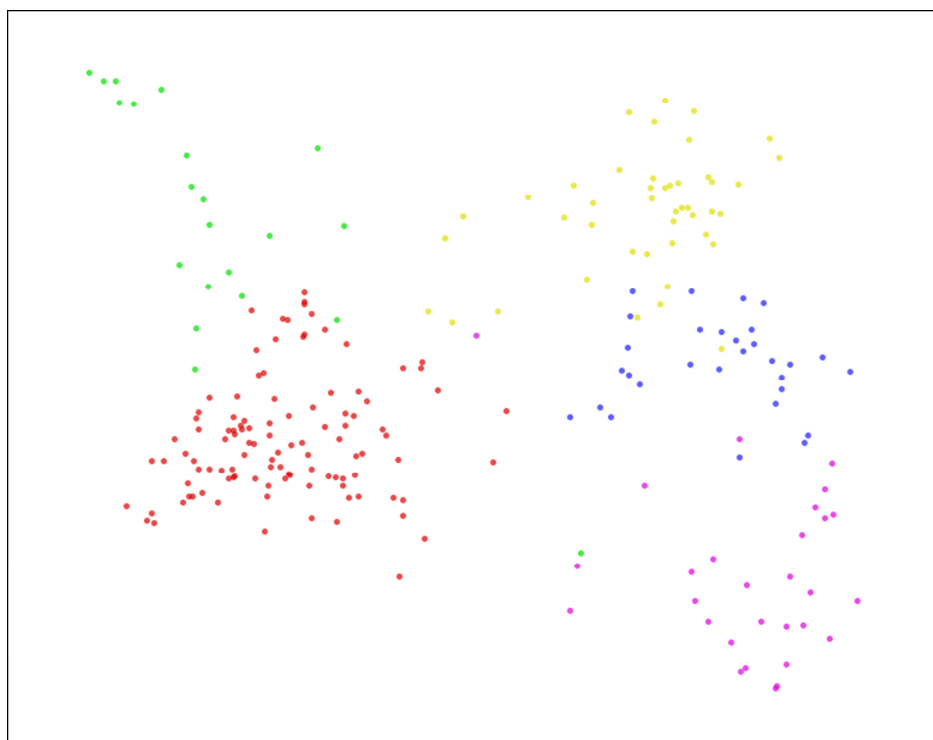**Figure 5. The cluster density view.**

Figure 6. The scatter view.

2.2 Overview panel

As can be seen in Figure 2, the overview panel of VOSviewer is used to show an overview of the currently active map. Items in the map are indicated by a dot. If colors have been assigned to items, each item's dot is displayed in the color of the item. A rectangular frame is displayed in the overview panel to indicate which area of the currently active map is shown in the main panel. In this way, one can see on which area of the map one is currently zoomed in. By left-clicking in the overview panel, one can change the area of the currently active map that is shown in the main panel.

2.3 Action panel

The action panel of VOSviewer can be used to undertake various actions. The panel consists of the following four tabs:

- **Action**. This tab contains the following buttons:

  o **File**.

    - **Open map**. Use this button to open a map. The currently active map will be closed. The **Open map** button brings up the **Open Map** dialog box discussed at the beginning of this section.

    - **Save similarities**. This button can be pressed only if a co-occurrence matrix is available in memory. When constructing a map based on a co-occurrence matrix, the co-occurrence matrix is used to obtain a similarity matrix (for more details, see Van Eck and Waltman, 2009a, 2009b). The **Save similarities** button can be used to save this similarity matrix. The matrix is saved in a similarities file. Similarities files are discussed in Subsection 3.4.

    - **Save coordinates**. Use this button to save the coordinates and the weights of the items in the currently active map. The coordinates and the weights are saved in a coordinates file. Coordinates files are discussed in Subsection 3.3.

  o **Screenshot**.

    - **Copy to clipboard**. Use this button to make a screenshot of the contents of the main panel and to copy this screenshot to the clipboard. The screenshot can for example be pasted into a Word document or a PowerPoint presentation.

- **Save**. Use this button to save a screenshot of the contents of the main panel. The screenshot resembles the contents of the main panel as closely as possible (except that the navigation buttons are omitted). Screenshots can be saved in a number of popular graphic file formats. For most applications, we recommend the PNG format. Some formats, such as EPS, PDF, and SVG, make use of vector graphics when saving a screenshot. This has the advantage that the screenshot can be resized without loss of quality. We note that Figures 3 to 6 were obtained using the screenshot functionality of VOSviewer.

- **Print**. Use this button to print a screenshot of the contents of the main panel.

- **Info**.

  - **VOSviewer manual**. Use this button to open the VOSviewer manual.

  - **About VOSviewer**. Use this button to view some general information about VOSviewer. The button brings up a dialog box that shows the version number of VOSviewer, a copyright notice, a license text, and the address of the VOSviewer web site.

- **Find**. This tab can be used to search for an item in the currently active map. Searching works in a straightforward way. First, one enters a search string in the text box located above the **Find** button. One then presses the **Find** button. VOSviewer will provide a list of all items whose label contains the search string. Next, one selects one of the items in the list and one presses the **Show** button. VOSviewer will zoom in on the selected item.

- **VOS**. The **Run** button on this tab can be used to run the VOS mapping technique (for a detailed discussion of the VOS mapping technique, see Van Eck and Waltman, 2009a, 2009b). This button can be pressed only if a co-occurrence matrix is available in memory. The **VOS** tab also allows one to change the values of the following parameters of the VOS mapping technique:

  - **Random starts**. This parameter determines the number of times the optimization algorithm of the VOS mapping technique is run. Each time the optimization algorithm is run, a different randomly generated initial solution is used. Increasing the number of times the optimization algorithm is run increases the likelihood of finding a globally optimal solution.

  - **Random seed**. This parameter is used to randomly generate a set of initial solutions for the optimization algorithm of the VOS mapping technique. A

given random seed always yields the same set of initial solutions. An exception is random seed 0. This random seed yields a different set of initial solutions each time the VOS mapping technique is run.

- o **Convergence**. This parameter determines the convergence criterion used by the optimization algorithm of the VOS mapping technique.

- o **Max. iterations**. This parameter determines the maximum number of iterations performed by the optimization algorithm of the VOS mapping technique.

- **Options**. This tab can be used to change various settings of VOSviewer. The following settings can be changed:

- o **Labels**.

  - **Size effect**. In the main panel, the higher the weight of an item, the larger the font size used to display the item's label. The **Size effect** slider determines the strength of this effect.

  - **Max. length**. This text box indicates the maximal length of a label displayed in the main panel.

  - **No overlap**. This check box determines whether labels should be allowed to overlap each other in the main panel. If overlapping labels are not allowed, it depends on items' weights which labels are displayed and which are not.

  - **Blurred background**. This check box determines whether a blurred background should be used in the main panel. Using a blurred background, labels that are not displayed in the ordinary way (due to overlap with other labels) are displayed in a blurred way. The **Blurred background** check box has an effect only if the **No overlap** check box is selected.

  - **Gradual appearance**. This check box determines whether in the main panel labels should appear gradually or instantaneously when one zooms in. The **Gradual appearance** check box has an effect only if the **No overlap** check box is selected.

- o **Label view**. The option buttons can be used to select the way in which labels are displayed in the label view. Using the **Show labels and circles** option button, labels are displayed together with a circle. Using the **Show labels and frames** option button, labels are displayed within a frame.

Using the **Show labels only** option button, labels are displayed without any additional elements.

- o **Density view**.

  - ▪ **Kernel width**. This slider determines the value of the kernel width parameter (for a discussion of this parameter, see Van Eck and Waltman, 2009a, 2009b).

  - ▪ **Color transformation**. This slider determines the value of the color transformation parameter (for a discussion of this parameter, see Van Eck and Waltman, 2009a, 2009b).

  - ▪ **Color scheme**. This drop down list can be used to select a color scheme for the density view.

  - ▪ **Use white background in cluster density view**. This check box determines whether a black or a white background color should be used in the cluster density view.

- o **Files**.

  - ▪ **Use sparse format for similarities files**. This check box determines whether a sparse or a full format should be used when saving a similarity matrix in a similarities file (see Subsection 3.4).

  - ▪ **Ignore main diagonal in co-occurrences files**. This check box determines whether the main diagonal in a co-occurrence file should be ignored when opening a map. If the elements on the main diagonal in a co-occurrence file are all non-zero, they are used as weights of items (see Subsection 3.2). This can be avoided by selecting the **Ignore main diagonal in co-occurrences files** check box. In general, we recommend selecting this check box.

2.4 Information panel

The information panel of VOSviewer can be used to display information about one of the items in the currently active map. For example, when one moves the mouse over the label of an item in the main panel, information about the item can be displayed in the information panel. By default, the information panel is shown only if descriptions of items have been provided in the items file (see Subsection 3.1). The height of the information panel can be adjusted. This can be done by dragging the area between the information panel and the main panel using the mouse.

3 File types

In this section, we discuss the file types used by VOSviewer. Except for saving screenshots, VOSviewer only works with simple text files. Such files can be viewed and edited using any text editor (e.g., Notepad in Windows), and they are supported by a large number of computer programs. Below, we sometimes say that a text file consists of several columns. By this we mean that each line in the file contains several pieces of information. Different pieces of information on the same line are separated from each other by a comma, a semicolon, or a tab. We note that the example files to which we refer in this section are distributed together with VOSviewer.

3.1 Items file

An items file is a text file that contains the labels of the items in a map. In addition, an items file may also contain descriptions and colors of items. An items file consists of at least one and at most six columns. Each line in the file corresponds with an item. The first column contains for each item its label. The second column contains for each item its so-called secondary label. In the main panel, the secondary label of an item is displayed below the item's ordinary label. Secondary labels are displayed using a small font. The use of secondary labels is optional. The third column contains for each item its description. The description of an item is used to provide information about the item in the information panel. Descriptions can be formatted using HTML tags. The use of descriptions is optional. If a label, a secondary label, or a description contains commas or semicolons, it needs to be enclosed within double quotes. The fourth, fifth, and sixth column of an items file can be used to specify colors of items. If no colors are specified in an items file, items all have the color gray. Colors can be specified in the following two ways:

- If an items file consists of four columns, the fourth column contains for each item an integer (1, 2, …) that indicates the cluster to which the item belongs. Each cluster has a predefined color, and each item has the same color as the cluster to which it belongs. When an items file is used in which clusters are specified, the cluster density view becomes available in the main panel of VOSviewer (see Subsection 2.1). For an example of an items file consisting of four columns, see the file `journal_data_set_items.txt`.

- If an items file consists of six columns, the last three columns contain for each item the red, green, and blue components of its color. Color components are

integers between 0 and 255. For an example of an items file consisting of six columns, see the file `journal_data_set_items2.txt`.

We note that, if no secondary labels and no descriptions are used, the corresponding columns of an items file may be omitted altogether. In that case, the second, third, and fourth column of an items file can be used to specify colors of items.

3.2 Co-occurrences file

A co-occurrences file is a text file that contains a co-occurrence matrix based on which a map can be constructed. A co-occurrences file has one of the following two formats:

- *Full format*. The entire co-occurrence matrix, including elements that are equal to zero, is stored in the co-occurrences file. The file consists of n lines and n columns, where n denotes the number of items. The element in the ith row and the jth column of the co-occurrence matrix is stored on the ith line and in the jth column of the co-occurrences file. The co-occurrence matrix stored in the co-occurrences file must be symmetric. For an example of a co-occurrences file that has a full format, see the file `journal_data_set_cooccurrences.txt`.

- *Sparse format*. Only the non-zero elements of the co-occurrence matrix are stored in the co-occurrences file. The file consists of three columns. The first two columns contain integers (1, …, n) that indicate rows and columns of the co-occurrence matrix. The third column contains the corresponding elements of the co-occurrence matrix. Due to the symmetry of the co-occurrence matrix, only half of its non-zero off-diagonal elements need to be stored in the co-occurrences file. For an example of a co-occurrences file that has a sparse format, see the file `journal_data_set_cooccurrences2.txt`.

Regardless of the file format that is used, the main diagonal of a co-occurrence matrix can be handled in the following two ways:

- If the main diagonal of a co-occurrence matrix contains only non-zero elements, VOSviewer interprets each element on the main diagonal as the total number of occurrences of an item and uses it as the item's weight. We note that this only works if the **Ignore main diagonal in co-occurrences files** check box, which can be found on the **Options** tab in the action panel of VOSviewer, is not selected.

- If the main diagonal of a co-occurrence matrix contains elements that are equal to zero, VOSviewer calculates for each item the total number of co-occurrences and uses this number as the item's weight.

3.3 Coordinates file

A coordinates file is a text file that contains the coordinates and possibly also the weights of the items in a map. A coordinates file consists of two or three columns. Each line in the file corresponds with an item. The first two columns contain for each item its horizontal and vertical coordinates in the map. The third column contains for each item its weight, that is, its total number of occurrences or co-occurrences. The use of weights is optional. If no weights are used, VOSviewer assumes that all items have the same weight. For an example of a coordinates file, see the file `journal_data_set_coordinates.txt`.

3.4 Similarities file

A similarities file is a text file that contains a similarity matrix. A similarity matrix is a matrix that is used by VOSviewer during the construction of a map (for more details, see Van Eck and Waltman, 2009a, 2009b). A similarities file has either a full or a sparse format. These formats are similar to the corresponding formats of a co-occurrences file (see Subsection 3.2). When saving a similarity matrix, VOSviewer uses a sparse format if the **Use sparse format for similarities file** check box, which can be found on the **Options** tab in the action panel of VOSviewer, is selected. If this option is not selected, VOSviewer uses a full format. For an example of a similarities file that has a full format, see the file `journal_data_set_similarities.txt`. For an example of a similarities file that has a sparse format, see the file `journal_data_set_similarities2.txt`.

References

N.J. van Eck and L. Waltman. VOSviewer: A computer program for bibliometric mapping. Technical Report ERS-2009-005-LIS, Erasmus University Rotterdam, Erasmus Research Institute of Management, 2009a. Available online at http://hdl.handle.net/1765/14841.

N.J. van Eck and L. Waltman. VOSviewer: A computer program for bibliometric mapping. In B. Larsen and J. Leta, editors, *Proceedings of the 12th International Conference on Scientometrics and Informetrics*, pages 886–897, 2009b.