

## **Vibrations for Windows Help**

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## **About Vibrations for Windows**

Vibrations for Windows is a program for displaying normal modes of vibration . The program can display the modes of vibration with arrows or as an animation. The static display may be saved as a windows bitmap file (Save \*.bmp), copied to the clipboard (Copy) or printed (Print).

**Normal Modes of Vibration** are the key to description of molecular vibration. In general, a normal mode is an independent, synchronous motion of an atom or group of atoms that may be excited without leading to the excitation of any other normal mode. Any vibration, however complicated, may be expressed as a superposition of the normal modes. A molecule has  $3N-6$  normal modes, where  $N$  is the number of atoms, or  $3N-5$  if it is linear.

## **File Menu**

The file menu commands allow the manipulation of files and data.

<u>O</u> pen	Opens <u>Vibrations for Windows</u> File
<u>S</u> ave *.bmp	Saves the displayed image as a Windows bitmap file.
<u>E</u> xtract	Extracts Vibrations for Windows data from a <u>Gaussian 90</u> file.
<u>S</u> ave Data	Saves Data in <u>Vibrations for Windows Format</u> .
<u>P</u> rint	Prints the displayed image.
<u>E</u> xit	Exits the program..
<u>A</u> bout	About the author.

## **Edit Menu**

**Copy** Copies the current image to the clipboard.

## Vibrations Menu

The vibrations menu contains commands for selecting and displaying the normal modes.

Choose                      Choose the normal mode to display.

Draw                        Draw the molecule with arrows to show the normal modes.

Animate                    Animate the normal mode.

## Options Menu

This menu contains the options for displaying the normal modes

<u>Colour / Black and White</u>	Switches colour on and off.
<u>Scale Atoms</u>	Scales the radii of the atoms.
<u>Scale Vibrations</u>	Scales the amplitudes of the vibrations.
<u>Line Thicknesses</u>	Choose the thickness of the drawing lines.
<u>Rotate Axes</u>	Choose the rotation of the axes to change the view.
<u>Label Atoms / No Labels</u>	Switches the labelling of the atoms on and off.
<u>Speed</u>	Change the <u>animation</u> speed.

## **Help Menu**

The Help Menu Item displays this screen: [Vibrations for Windows Help](#)

**File Menu Open Command**

This command opens a file in Vibrations for Windows Format.

**File Menu Save \*.bmp**

This command saves the image currently displayed in the main window as a Windows bitmap file that may be imported into MS Paintbrush, Word for Windows etc.

## **File Menu Extract**

This command extracts Vibrations for Windows data from the output file of a Gaussian 90 frequency calculation.

## **File Menu Save Data**

This command saves data in Vibrations for Windows Format. The data may have been read in Vibrations for Windows Format using the File Menu Open command or from a Gaussian 90 frequency calculation output file using the File Menu Extract.

**File Menu Print**

Prints the currently displayed image on the default printer.

**File Menu Exit**

Closes Vibrations for Windows.

## **About the Author**

The author is currently studying for Ph.d. in molecular spectroscopy at Monash University, Melbourne, Australia.

## **Gaussian 90**

Gaussian 90 is a molecular orbital program for calculating the structure, normal modes and frequencies of vibrations, and other properties of molecules. The data required for Vibrations for Windows may be acquired from Gaussian 90 frequency calculation output files using the File Menu Extract command.

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Gaussian 90, Revision F, M. J. Frisch, M. Head-Gordon, G. W. Trucks, J. B. Foresman, H. B. Schlegel, K. Raghavachari, M. Robb, J. S. Binkley, C. Gonzalez, D. J. Defrees, D. J. Fox, R. A. Whiteside, R. Seeger, C. F. Melius, J. Baker, R. L. Martin, L. R. Kahn, J. J. P. Stewart, S. Topiol, and J. A. Pople, Gaussian, Inc., Pittsburgh PA, 1990.

## Vibrations for Windows File Format

The Vibrations for windows file format ,read in by the File Menu Open command is a text file with the following fields:

**Title** A character string of up to 40 characters

**Linear** A character string which should be linear if the molecule is linear, otherwise it may be anything.

**No of atoms** May be up to 20.

**Atomic no., Adjoining atom, Cartesian coordinates.** For each atom a line containing the atomic number, the number of the atom to which it is joined and the coordinates (x,y,z) of the atoms

**Normal coordinate vectors.** For each normal mode and for each atom, the x,y,z coordinates of the vector representing the motion relative to the cartesian coordinates entered above.

Below is the input file for Water

Water

```
3
8 0 0.000000 -0.127165 0.0
1 1 0.758071 0.508658 0.0
1 1 -0.758071 0.508658 0.0
0.00 -0.07 0.00
-0.45 0.54 0.00
0.45 0.54 0.00
0.00 -0.05 0.00
0.57 0.42 0.00
-0.57 0.42 0.00
0.07 0.00 0.00
-0.54 -0.45 0.00
-0.54 0.45 0.00
```

The data for Vibrations for Windows files may be obtained from different sources such as the Ampac molecular structure program or from Gaussian 90 using the File Menu Extract command.

### **Vibrations Menu Choose**

Before displaying a vibration you must choose one with this command. Select the desired vibration from the Select a Vibration window. Note that the numbering of the vibrations is simply in the order that they are read in and not in Mulliken classification order. If the normal modes are read in from Gaussian 90 file then they will be in order from lowest to highest frequency.

### **Mulliken Classification of Vibrations.**

The standard method of numbering normal modes of vibrations is from the highest frequency, highest symmetry mode to the lowest frequency, lowest symmetry mode. Vibrations for Windows simply numbers them in the order that they are read in.

## **Vibrations Menu Draw**

This command displays the molecule in a static form in the main window according to the options chosen in the Options Menu and representing the normal modes by arrows from the centre of the atoms in the reference structure. If the magnitude of the vector representing the motion of an atom is less than the radius of the atom than the arrow will not appear. It may be forced to appear by scaling the radii and motions of the atoms with the Options Menu Scale Atoms and the Options Menu Scale Vibrations commands.

### **Vibrations Menu Animate**

This command displays the molecule in the Animation window. The reference structure is swapped for the structure after the atoms have been displaced to the positions indicated by the normal mode vector read in by either the File Open or the File Extract. command. The delay between swapping images may be set with the Options Speed command.

### **Options Menu Colour / Black and White**

This command switches the colour of the atoms on and off.

### **Options Menu Scale Atoms**

This command brings up a dialog box with a scroll bar. Move the thumb track to the right for larger atoms and to the left for smaller ones. The displayed radii are proportional to covalent radii. By a judicious choice of atom scaling and scaling vibrations with Options Menu Scale Vibrations it should be possible to make arrows appear with the Vibrations Menu Draw command that would be otherwise invisible.

## **Options Menu Scale Vibrations**

This command brings up a dialog box with a scroll bar. Move the thumb track to the right for larger motions of the atoms and to the left for smaller motions. By a judicious choice of scaling vibrations and scaling the displayed atomic radii with Options Menu Scale Atoms it should be possible to make arrows appear with the Vibrations Menu Draw command that would be otherwise invisible.

## **Options Menu Line Thicknesses**

With this command you can select the thickness of the lines to draw the outline of the atoms, the bonds and the arrows representing the motions. Thinner lines means the images will be drawn more quickly.

### **Options Menu Rotate Axes**

This command allows you to rotate the coordinate system in which the molecule is drawn. The Axes window has two scroll bars: the horizontal bar rotates around the z axis and the vertical one about the z axis. The Swap button swaps the z and x axes which is equivalent to a rotation of 90 degrees about y followed by a reflection in the zy plane. The z molecule axis is projected onto the -y screen axis and the x molecule axis onto the x screen axis.

**Options Menu Label Atoms / No Labels.**

This options switches the labelling of the atoms on and off. If the atom has a higher atomic number than Lanthanide this option will not work.

**Options Menu Speed.**

This options allows the delay between new images in the Animation window. Move the scroll bar in the Speed dialog box to the right for a slow vibration and to the left for a fast one.

## **Gaussian 90 Files.**

The File Menu Extract command can read in the text file output from a Gaussian 90 calculation.

