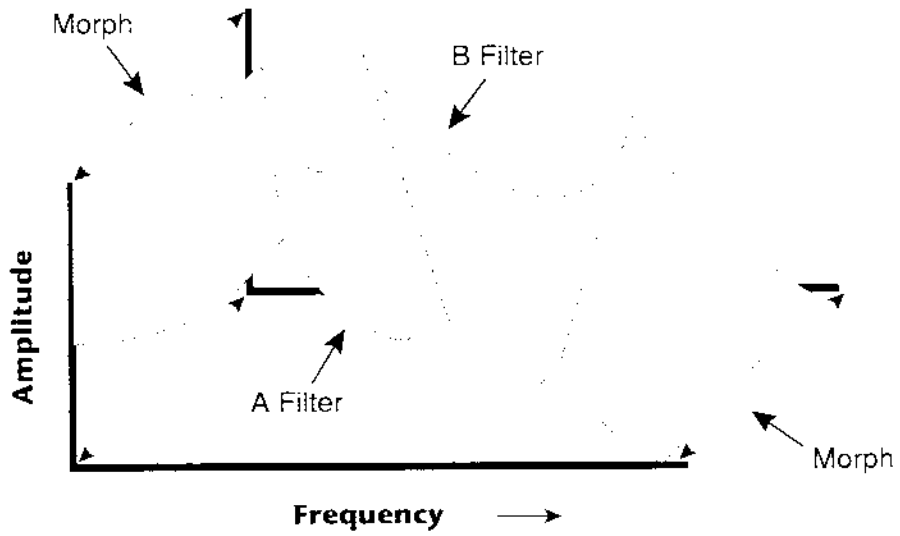
Consider, as an example, the human vocal tract, which is a type of complex filter or resonator. There are dozens of different muscles controlling the shape of the vocal tract. When speaking, however, we don't think of the muscles, we just remember how it feels to form the vowels. A vowel is really a configuration of many muscles, but we consider it a single object. In changing from one vowel to another, we don't need to consider the frequencies of the resonant peaks! You remember the shape of your mouth for each sound and **interpolate** between them.

THE Z-PLANE FILTER

In a simple Morpheus filter, we would start with two complex filters and interpolate between them using a single parameter. Refer to the diagram below.



The Morpheus Z-plane filter has the unique abilty to change its function over time.

Filters A and B represent two different complex filters. By changing a single parameter, the ***Morph***, many complex filter parameters can now be changed simultaneously. Following along the Morph axis you can see that the filter response smoothly interpolates between the two filters. This is the essence of the Z-plane filter. Through the use of interpolation, many complex parameters are condensed down into one manageable entity.

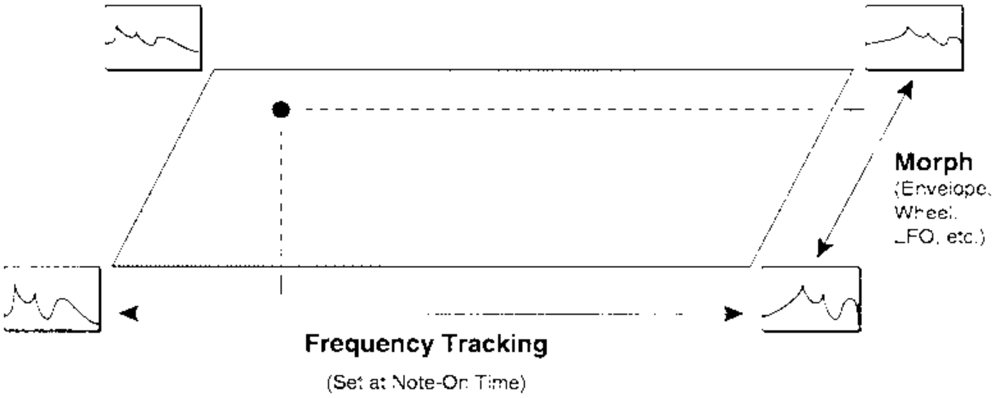
This Z-Plane filter sweep can be controlled by an envelope or function generator, an LFO, modulation wheels or pedals, keyboard velocity, key pressure, etc. In fact, any of the modulation sources can control the Z-Plane filter.

Because creating the complex filtering is difficult and very time consuming, we have created hundreds of filters and installed them permanently in ROM for your use. You simply select and use the filters in a manner similar to choosing an instrument. Because there are so many types of filters to choose from, the number of possible permutations is staggering. For example, you could play a guitar sound through a vocal tract filter and create a talking guitar sound. Or you could have an acoustic guitar whose body shape changes as you play.

In the current example, two complex filters were created and the Morph parameter was used to interpolate between them. This is the simplest way to visualize a Morpheus filter

The next logical extension of this two filter model would be to add yet another filter pair. The diagram below shows an example using four filters. Now we have *two* parameters that can be controlled.

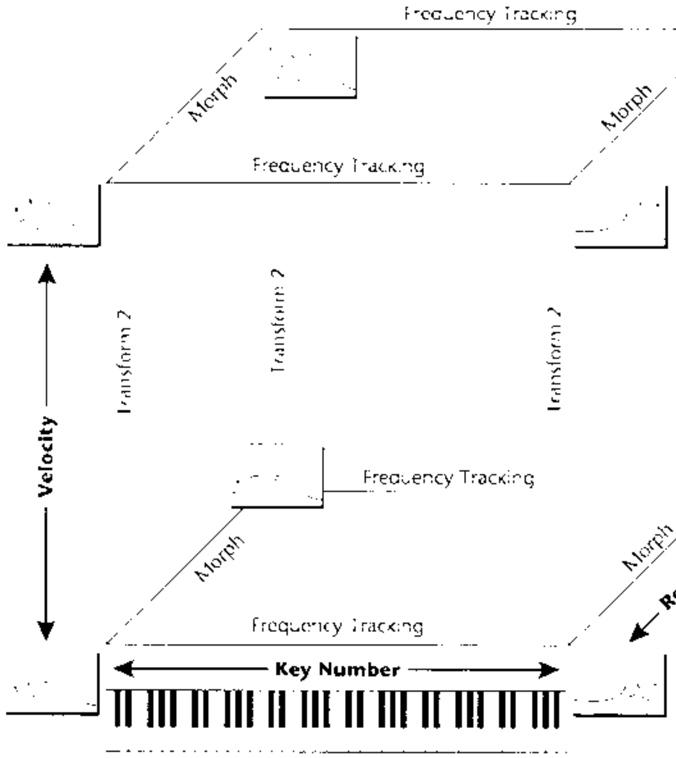
••• See the Step-By-Step chapter for more information on the Z-plane filters.



The diagram above, adds a *Frequency Tracking* parameter which varies the frequency of the filter. If we had set the frequency tracking and morph parameters as shown in the diagram above, the dot would represent the resulting filter position: a mixture of all four, but closest in nature to the left rear filter.

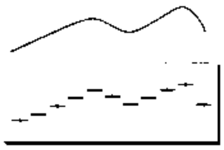
In the Morpheus filter there is *only one* parameter that can be continuously varied in realtime and that is the ***Morph*** parameter. Other filter parameters, such as *Frequency Tracking*, can only be changed at note-on time.

Suppose we added yet another dimension to the filter model. We could have the realtime *Morph* parameter, the *Frequency Tracking* parameter (set at note-on time) and one more parameter, perhaps controlling the amount of the filter peaks with key velocity. A way to visualize a three-dimensional filter model is shown by the diagram below.



The ***Cube*** *filters are actually constructed of up to eight different complex filters.*

••• *If the frequency graphs at the corners of the cube are confusing you, think of them as the settings on a graphic equalizer.*



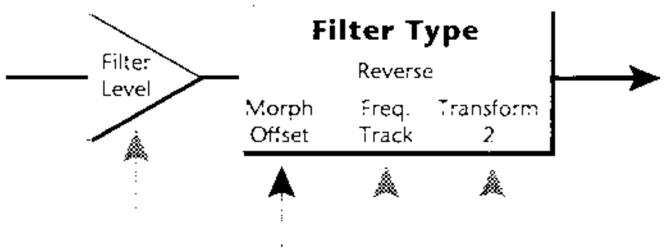
Each axis of the three-dimensional cube changes the filter in a different way. In the example above, key number is being applied to the Frequency Tracking parameter in order to make the filter frequency track or follow the notes played on the keyboard. Assigning the Keyboard to frequency is called *Key Tracking* and is used to keep the timbre of the sound constant as you play up and down the keyboard. Without key tracking the sound would get duller as you move up the keyboard and could sound completely different at opposite ends of the keyboard. Because Frequency Tracking is so important it has been assigned its own parameter which is used in many of the filters (there are exceptions).

In the filter model above, there is another note-on (defined at the time the note is pressed) parameter, ***Transform 2***. Unlike the Frequency Tracking parameter, the effect of Transform 2 may vary from filter to filter. In the example above, Transform 2 is being used to vary the size of the peaks and notches in the filter. The frequency plots in the upper plane of the cube have sharper peaks. Key velocity could be used to control Transform 2 and the sharpness of the filter peaks.

••• *Note: The Frequency Tracking parameter is Transform 1.*

• *Another View*

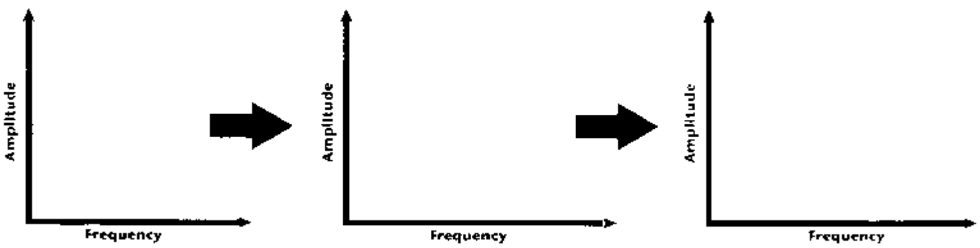
Another way to look at the Z-Plane filter is simply as a "black box". You don't really need to think about all the possible filter permutations in order to use it. You just need to know what the controls do and listen to the sound. Each Z-Plane filter is described in the Reference Section of this manual.



The Z-Plane filter can change its function in time.

Imagine a Lowpass filter transforming into a Bandpass filter. The Morph parameter (Morph Offset) typically handles this type of function.

Lowpass Filter Morphing into a Bandpass Filter



••• On some filters, the Frequency Tracking parameter DOES NOT control the filter frequency. See the filter descriptions in the Reference Section for details.

The Morph and Transform 2 parameters vary in function from filter to filter. **About half of the Z-Plane filters are not Cubes and therefore DO NOT use Transform 2.** The Frequency Tracking parameter usually controls the frequency of the filters, moving peaks, shelves or notches up and down in frequency. Refer to the Reference Section of this manual for specific information on each filter.

Many of the filter types in Morpheus are models of traditional acoustic instruments such as electric piano or guitar. When an electric piano sample is played through an electric piano filter, the harmonics of the sample can now be controlled using the filter parameters.

Of course, you can put any instrument through the filter and the filter will shape the basic character of the instrument. This "building-block" approach to synthesis is only a part of what makes Morpheus such a unique and powerful synthesizer.