Eventide
the next step
Technical Note #72

Clicks and other noises when changing parameters

A digital filter is comprised of a network of short time delays with many and variable feed-back and feed-forwards paths mixed in to the main signal path. The amount of signal fed back or fed forwards along each of these paths is controlled by a gain multiplier, whose gain is known as a *coefficient*. It is these coefficients that are varied when you change filter parameters on a Harmonizer.

As a result, if a filter parameter is changed rapidly, the following may happen:

1) If the parameter controls gain, for example a boost or cut, when signal is passing through the filter, the resulting step change in gain will cause a click depending on the signal amplitude and the amount of gain change (just as a switched gain control would in an analogue system).
2) If the filter parameter controls bandwidth or centre frequency, the results are more complex and depend on the filter design. In some filters, changing the parameter results in several coefficients changing together - since these cannot change at exactly the same point in time, there may be an instant where their values are non-compatible, which will cause an instability in the filter - this may result in a click. In other filters, this instability will not occur, and the situation will be as for gain changes above.

There are various ways we can try to reduce the above effects:

1) By trying to use filter designs that do not show the above instability. Obviously our designers will do this where possible, but some valuable effects can only be obtained from certain filter designs - in this case we are confident that the user would prefer them to be available.
2) To smooth parameter changes to reduce step size - this will help with gain changes, but will increase 'rubberiness' of controls and will reduce responsiveness. V2.0 software for the DSP4000 includes a *c_smooth* module that could be placed in a control path in a patch to do this. However, any smoothing consumes precious DSP processing power, so in general control paths are 'live', or un-smoothed.
3) To duplicate the signal processors on a before and after basis and crossfade between them when a change is made. This will remove almost all parameter change artefacts, but doubles the cost (or halves the power) of the DSP processor, which would be unpopular with users.

In conclusion, some artefacts from fast parameter changes are almost unavoidable at times, and realtime parameter changes should be made with this understanding.