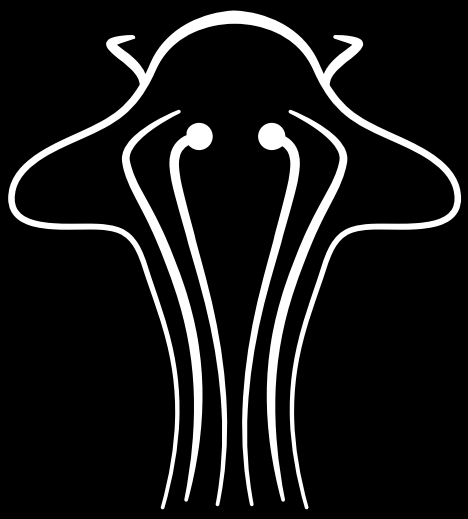
Mariana Trench



Mariana Trench - FDN Effects for Tiptop Audio Z - DSP

Background:

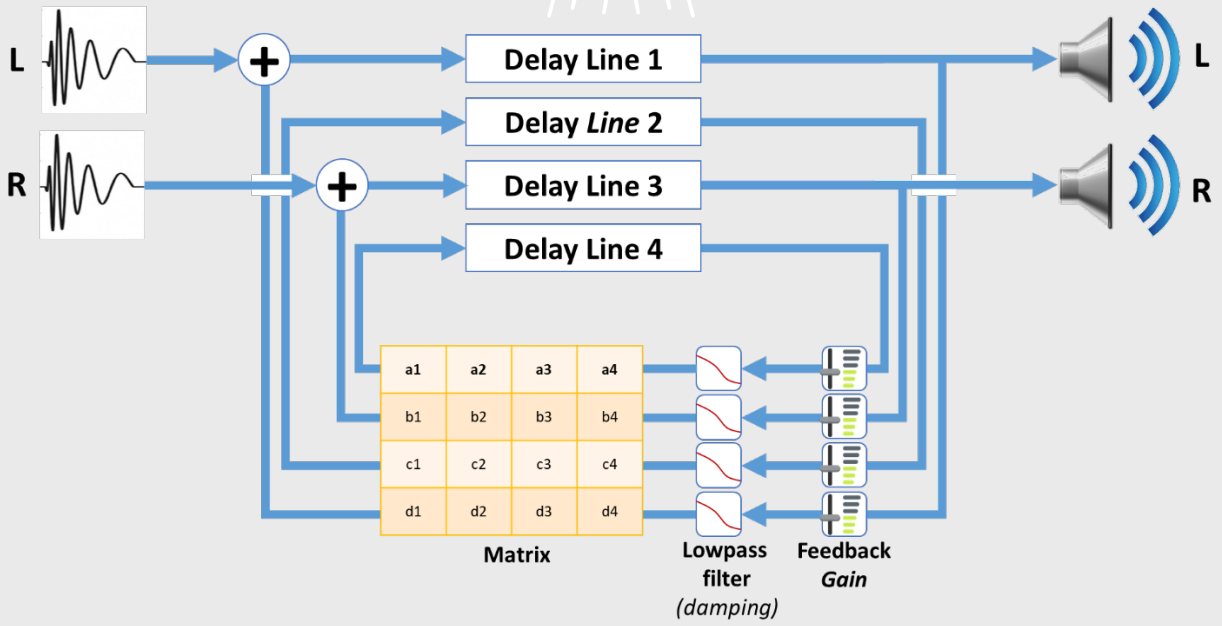
FDN (Feedback Delay Network)

Feedback Delay Networks (FDNs) are built around multiple delays which are connected to their inputs thanks to a feedback matrix designed for its stability and lossless properties.
FDN can mimic the recursive process of sound waves bouncing back and forth in an acoustic space. They were first suggested for artificial reverberation by Michael Gerzon (1971) and later John Stautner and Miller Puckette (1982) introduced four-channel FDN reverberator with general stability conditions. A lot of very famous brands are using FDN in their reverberation algorithms.

But FDN can also be used as a special case of digital waveguides, they can be tuned, or also used as complex delays. The Mariana Trench Z-DSP cartridge is designed to explore these more unusual sides of the FDN algorithms.

How it works:

In the context of the Z-DSP, the FV1 chip (its brain) computes these FDN algorithms. Despite its limited power, the nice design of the chip allows, with a consequently optimised code, running a four delay line FDN.
The following figure provides a schematic overview of the FDN as it is implemented in Mariana Trench (of course, this structure slightly vary across the 8 programs, and also include some important optimisations).



The full FV1 delay line is split 4 parts and necessary low pass filters (and sometimes a DC-cut) are inserted in each feedback loop. A feedback gain is also available, allowing to tune the reverberation decay as well as the delay length when used as the delay.
The colour of the FDN is strongly affected by the choice of the feedback matrix as well as the delay-line lengths usually selected as ideally mutually primes.
Also the full delay line is always available, the Z-DSP controls have been used to be able to use these delays from length of a few samples up to their full length.

The Mariana Trench Z-DSP FDN algorithms can be used in different ways:

- as a classical reverberation, using long delays (low pitch) and setting the decay thanks the Feedback parameter and the colour with the Damping: you can get incredibly long and huge reverberation that way
- as a delay, using long delays (low pitch) and low Feedback, getting complex delays that you can, for example, use to animate drums or sequences
- a very interesting way of using Mariana Trench algorithms is to take advantage of the Feedback capability of the Z-DSP: set the FEEDBACK 1 or FEEDBACK 2 knob of you Z-DSP to 75% to 100% and tweak the VC-DSP knobs (you don't even need any input): you will get amazing evolving texture. This usage is especially effective with "*FDN Modulated*" programs (5 and 6)
- input set a very short delay (high pitch) and very high feedback, input very short sound burst or impulses and let the FDN ring, and possibly use CV inputs (or Knobs) to tweak and make the sound alive. A variant is, of course, to use drum sounds as input. Very interesting results can also be obtained using sequences. For drums and sequences, the damping needs to be lowered to fit the BPM.
- etc.

Controls:

All the Mariana Trench FDN models have common controls:

- Left and right **audio inputs** can be used the same way
- Control 1 (**Freq**) is defining the global delay line length used by the FDN. It is named Freq (for Frequency) since it will control the pitch frequency (try with low values, and then switch to high values you will understand what this mean). Turn left to get high frequencies (short delays) and right for low frequencies (long delays)
- All programs have **Damping** and/or **Feedback** (sometime coupled on the same VC)
  - **Damping** set the cut-off frequency of the low pass filter inserted in the loop (see figure above): low damping, meaning longer ringing, is clockwise.
  - **Feedback** controls the gain in the feedback loop (see figure above): higher gain is clockwise (when set to 100% together with Damping, you can get an almost infinite ring).
- **FEEDBACK1** and **2** knobs of the Z-DSP may always appear to be useful !

Programs:

1> FDN FeedBack

Traditional Feedback Delay Network with damping and feedback control. Great for huge reverberations.

Control 1 – Frequency (global delay line length). *See the Control section above*
Control 2 – Damping. *See the Control section above*
Control 3 – Feedback. *See the Control section above*

2> FDN High Pitch

Feedback Delay Network tuned to be used as a waveguide (best used with burst inputs or drum inputs, but works with any input)

Control 1 – Frequency (global delay line length but focused on a small range of short delays). *See the Control section above*
Control 2 – Damping. *See the Control section above*
Control 3 – High pass filter cut-off (inserted in the feedback loop) used to control the colour to the sound

3> FDN Unstable 1

Feedback Delay Network (same as program "*1> FDN FeedBack*") with unstable delay lines (fixed depth random changes) resulting in some pitch instability.

Control 1 – Frequency (global delay line length). *See the Control section above*
Control 2 – Damping. *See the Control section above*
Control 3 – Feedback. *See the Control section above*

4> FDN Unstable 2

Similar to program "*3> FDN Instable 1*" but with a fixed feedback (always 100%) and a controllable instability depth

Control 1 – Frequency (global delay line length). *See the Control section above*
Control 2 – Damping. *See the Control section above*
Control 3 – Instability depth (maximum percentage of change of the delay line's lengths).

5> FDN Modulated 1

Feedback Delay Network with controllable Damping and fixed Feedback (100%) with a modulated picking point in the delay lines: instead of getting the audio output from the end of the delay line, it is picked up from a point within delay line (so the delay line used for the FDN itself remains constant), and the pick-up point position is modulated.

Note that this program, together with the next one is really great to be used with the **FEEDBACK1** or **2** knobs of the Z-DSP at 75% to 100% (in this case you may even not need any input)… then just tweak the VC knobs and have fun !!

Control 1 – Frequency (global delay line length). *See the Control section above*
Control 2 – Damping. *See the Control section above*
Control 3 – Modulation of the pick-up point position in the delay line: the depth and the speed are controlled together (the higher depth, the lower modulation frequency)

6> FDN Modulated 2

Feedback Delay Network with controllable Damping and Feedback linked together, and with a modulated picking point in the delay lines: instead of getting the audio output from the end of the delay line, it is picked up from a point within delay line (so the delay line used for the FDN itself remains constant), and the pick-up point position is modulated.

Note that this program, together with the previous one, is really great to be used with the **FEEDBACK1** or **2** knobs of the Z-DSP at 75% to 100% (in this case you may even not need any input)… then just tweak the VC knobs and have fun !!

Control 1 – Frequency (global delay line length). *See the Control section above*
Control 2 – Damping and Feedback (linked). *See the Control section above*
Control 3 – Modulation of the pick-up point position in the delay line: the depth and the speed are controlled together (the higher depth, the lower modulation frequency)

7> FDN Spread 1

Feedback Delay Network with controllable Feedback and fixed Damping, and with an adjustable spreading of the delay lines (the relative length of the 4 delay lines can be modified). When playing with the Spread control, the longest delay line remains unchanged, but the length of all the other delay lines is affected proportionally to the control.

Control 1 – Frequency (global delay line length). *See the Control section above*
Control 2 – Feedback. *See the Control section above*
Control 3 – Spreading (0% for intermediate shorter delays)

8> FDN Spread 2

Similar to "*7> FDN Spread 1*" but with different proportions between delays.

Control 1 – Frequency (global delay line length). *See the Control section above*
Control 2 – Feedback. *See the Control section above*
Control 3 – Spreading (0% for intermediate shorter delays)

Mariana Trench Z-DSP cartridge is designed by **Christophe Duquesne**
Anckorage - http://www.anckorage.com/
Haken Audio developement team – http://www.hakenaudio.com/Continuum/
La Voix du Luthier - http://www.la-voix-du-luthier.com/