

The Beginners Guide to Modeling with the Technics WSA1

Part 2 of the Technics WSA1 basic programming course

Introduction

This article gives the novice user a general introduction to the idea of acoustic modeling in the Technics WSA1 by adding a bit of basic understanding of the main principles to what the original user guides, which stay rather vague about such stuff, provide.

The quickest way to get to grips with the WSA is to see it as a sample ROM synthesizer with an extra modeling twist (or maybe a KN Series ++ for typical Technics fans). While other physical modeling synthesizers claim to use “perfect” all-encompassing algorithms (= especially written programs) for the recreation of acoustic sounds the WSA thus, at first sight, seems a bit of a compromise, especially since ROM synths are not known for being very expressive. As we will see such theoretical disadvantages are in practice however compensated by the overall flexibility of the system.

Layout

As we have seen in an earlier installment, a synthesizer can, with a little bit of goodwill, be described as consisting of 3 main stages:

1. The oscillator stage; in which the pitch of the notes is determined and the raw waveforms are generated
2. The filter stage; in which the timbre can be shaped in real time
3. The amplifier stage in which the amplitude of the signal = volume can be shaped in real time

The WSA's oscillator section (section 1) plays SAMPLES (= digital sound snippets). These reside in a so-called ROM (Read Only Memory) chip set. Basically the sample

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pool of the WSA can be compared to that of any ROM based synthesizer of the period. In this basic memory virtually all the waveforms one needs in contemporary music are stored, from percussion and drum sounds, through electric instruments, to basic analog synthesizer waveforms and orchestral sounds.

Sections 2 and 3 add a normal digital SUBTRACTIVE synthesis engine to this sample player. One can send the sounds through filters, envelope generators and modulate them with LFO's, controllers, etc...

Remark: Subtractive means that these sections are only able to subtract from the full frequency range of the waveforms or samples. In other words: Normally a subtractive synth can never add anything really new to the signal but only shape what is already there.

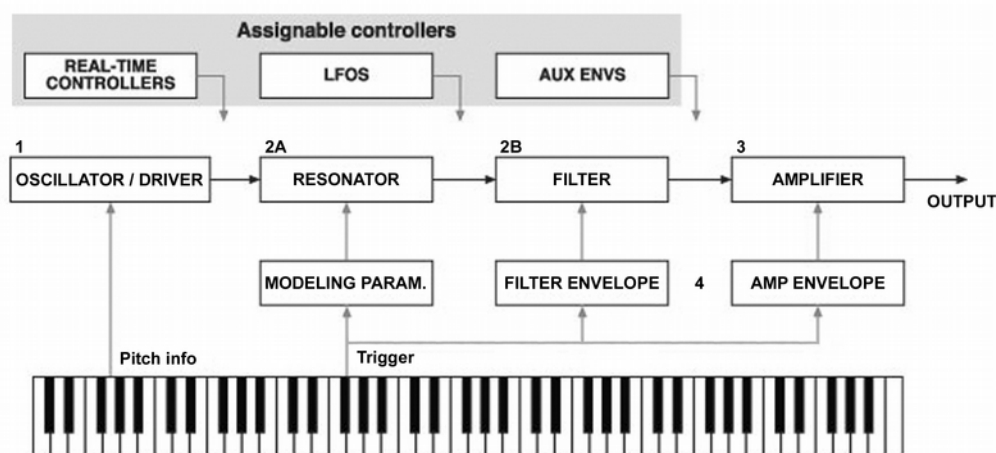
But what about the fabled acoustic or (as it is more often called) virtual modeling stuff then? The bits that are supposed to make the WSA so special? Well these can actually ADD new and exciting properties to a sound.

An extra section is therefore wedged between the oscillator and subtractive sections. It is called the MODELING section, so physical modeling is applied to the samples BEFORE the sound goes into the subtractive synthesis section.

Since modeling is mostly a tone quality shaping tool one could say that our overall timbral shaping section, Section 2, has been divided into 2 separate sub-sections. From now on we will therefore talk about:

- Section 2A: The modeling section.
- Section 2B: The filter section.

The rest of this text is intended as an introduction to the modeling functions of the WSA. We will thus mainly concentrate on section 2A.



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The Modeling Section

This is what actually happens in the WSA in user terms:

In section 2A the samples (called DRIVERS in WSA speak) can be sent through so called RESONATORS.

One could compare the process somewhat to how reverb was added to prerecorded material in the old days. A real chamber, room or cellar was used to amplify sound into. The ambient sound of the room was then re-recorded with all the reverb and echo that the chamber generates added to the original signal.

Basically that is what also happens in most acoustic instruments. The driver is the component that actually creates the sound (a hammer or pick striking a string, a reed resonating, etc.). The body of an acoustic instrument (the resonator) then actually adds a very short reverb with a very specific frequency content to the initial sound.

In a modeling synthesizer these resonating effects are (re)created by using special software models. The advantage of artificial resonators is that they are more flexible than any existing cellar, instrument body, or what-have-you. They can even change their properties in real time!

Recap

Well, that is indeed a lot to take in.

From a simple description containing the 3 main aspects of sound we are now confronted with a whole set of new, sometimes seemingly inconsistent, terms, as if certain aspects from that original division into pitch, timbre and amplitude are repeated a few times in different ways. Alas one cannot make it easier without leaving too much important stuff out. The only advice I can give is to read the previous section a few times until you get hold of the basics.

For now the main points are:

1. Within the WSA the oscillators use samples to generate the basic pitches and waveforms. These samples are called DRIVERS.
2. In the extra modeling section, placed between the oscillator section (1) and the normal filter section (from now on called 2B), there is an extra section, the

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MODELING section (section 2A), in which these basic sounds are modified with so called RESONATORS.

3. RESONATORS are digital models imprinting acoustic behavior upon the samples.

A Basic How-To Guide

One should not underestimate the WSA's modeling possibilities. They are much more than just a bonus but add a totally different approach to synthesis to the basic mix.

In this paragraph you will find a quick guide that allows the beginner to get a feeling for this approach.

1. Press MODELING
2. A page will open that shows you 4 layers. Select layer 2 and press MUTE.
3. Repeat the same for layers 3 and 4.
4. You will now only hear layer 1. The "oscillator" uses 1 sample / waveform to base its pitched rough material on.
5. Also check if the INTERACTION function between the layers is switched off. If it is off there will be no arrows present connecting the layers in the RESONATOR column (We'll get to this function later).
6. If you do not like the basic sound you can change it by selecting another sample via the GROUP and DRIVER buttons.
7. Scroll through the models in the RESONATOR column and select the one called THROUGH, which is combined with an arrow symbol. One could call this the MODELING OFF switch / option.
8. If you now play the keyboard you only hear this single layer. It might still be processed by all the subtractive elements further on in the chain but no modeling is applied so the WSA now behaves like a pure, sample based, subtractive synth. Have a good listen to this "naked" version.
9. All other places in the RESONATOR list inject a model into the sound path in the aforementioned 2A position. With these a specific character can be added to the sound. The available models are all indicated by a name but also by a small picture. The picture actually gives an indication of the general group the model belongs to.

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10. These groups are:

- ORIGINAL; Here all the factory samples combined with the model that is the most logical to use if one is doing pure imitative synthesis. A preset imitating a guitar sound will for instance always combine a sample of a guitar with a string model. That might not be a very original choice but one can see this option as a sort of programming aid for people who do not want to think too much about the whole modeling stuff.
- STRING ; adds behavior like that of a guitar or violin string,
- CYLINDER ; like a blown pipe, e.g. a flute
- CONE ; more like a woodwind body shape,
- FLARE ; like a brass bell mouth,
- PLATE ; like a resonating piece of sheet material,
- MEMBRANE; like a drum head).

11. Further on in the list most model symbols are repeated with another name, indicating a more specific character. You will for instance find indicators like, “mellow”, “mute”, “bright”, etc... These models are more specific versions of the overall model types and therefore add refined subdivisions.

12. Now switch through all these models by applying them to the single layer you kept active. You will hear the sound change significantly.

13. Initially you might think this is just like switching preset filters on and off but the truth is much more complex. They change over time, like they would in a real instrument and can react to all sort of controllers, like velocity, aftertouch, LFO's etc., etc... In other words: They behave dynamically in a way that is comparable to the originals their names imply. Want to add a percussive metal type of character to a sample? Why not try a BRIGHT PLATE then?

14. If you have gone through all the models you can start switching to other samples with the buttons marked GROUP (= sound group) and DRIVER (a specific sample within that group) and listen to what the models do to these.

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Interactions

There is one other unique feature I would like to point out here. It is a more general tool but also a very powerful one.

Remember that I asked you to switch the INTERACTION function off? Well now switch it back on.

If you keep pressing the switch several times you will find 3 options.

- To combine the 1st and 2nd layer.
- To combine the 3th and 4th layer
- To combine all layers.

Switch the other 3 layers in your sound on again.

Now scroll through the options mentioned under point 2 while playing the keyboard.

You will hear that the sound changes in quite extreme but also interesting ways. At first it might sound like the samples are simply mashed up by a sort of morphing function. But it can also do some quite refined stuff. If you, for instance, combine a short percussion sound with a sustained one you will hear that the sustained sound really takes on a part of the character of that single percussive hit even after that has died out itself!

Modulations Please

The WSA really comes to life when you start modulating things. LFO's are readily available (1 per layer so up to 4 LFO s per sound preset) but using real time control is the best way to add convincing expression.

There is velocity of course but beside 3 wheels the WSA also has its special 2D vector REALTIME CONTROLLERS. A trick I especially like to use is to modulate the sound with aftertouch but as long as you can spare one hand the other controllers will of course do just as well.

Anyway: Doing this sort of stuff really makes the WSA "sing" in a much more pronounced way that with a normal synthesizer. Sounds really change their character over time.

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Venturing On

You can now go in 2 basic directions:

1. If you want to recreate / emulate existing sounds you can think about what you are looking for and choose stuff accordingly. This can actually be a rather conscious process. No need to go for a bright plate model if you want to create the perfect Spanish guitar sound. Do on the other hand not be too restrictive in your choices. Especially in layered sounds the not so obvious combinations can still come in quite handy to get you where you want to go.
2. If you want to be creative and make unique sounds just go for the not so logical combinations anyhow. Ever wondered how it would sound to send a brass section through a wooden box? Why not try it anyway?

One of my favorite presets sounds like a big empty metal vessel is being struck with a pipe. By using the REALTIME CONTROLLER I can make it do all sorts of crazy things that sound like the vessel is suddenly shrinking or the wall becomes thicker or the material changes. So it really gives one the feeling that an instrument / object is molded in real time.

It's just a single example but if you get to grips with this system and learn to combine it with the huge set of basic samples the sky really is the limit. Well almost. Now if one could also load user samples! Man, it would then run even quicker rings around the competition then it already does, even up to this day.

The next step is to further expand your experiments by making use of all "normal" subtractive synthesis parameters, effect settings, etc... Just knock yourself out but don't forget; save everything you like before you go on and soon you'll be able to call yourself a real modeling programmer.

(Remark: The following appendixes contain a few more advanced thoughts. Only read them if the rest of the explanation has sunk in. Otherwise these few extra bits might actually only confuse you).

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Appendix A: Modeling Principles

Basically physical modeling (or acoustical modeling in Technics-talk) implies one major thing; that the behavior of real world instruments is emulated by an integrated computer model which, on the basis of certain variable input parameters, creates an output signal that sounds like the original instrument.

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Well, to formulate it in a more compact way:

1. Computer calculates
2. What comes out sounds like real thing

I'll not go into the specifics of how the technology actually works here but for those who want to delve deeper into the subject the following remarks might be of help:

Considering the vintage of the instruments one has to assume that we are talking about DIGITAL WAVEGUIDE MODELING, in which the behavior as described above is created by clever real time filtering and delay algorithms, thus using an approach that can be compared to that used in digital reverbs (which brings us almost full circle to the example of the echo chamber in the modeling section paragraph).

Snobby geeks might say that this is "just" a compromise that was thought up to work around the lack of processing power in the early 1990's and that recent virtual modeling is much more powerful and true to the principle. They would actually be right but hey; it did the job in the WSA and it still does. That's what counts, isn't it?

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Appendix B: WSA Limitations

As we have seen the WSA does not provide total physical modeling. One starts with “frozen” samples and not with driver models.

In “real” physical modeling synthesizers one always starts with a more complete, very specific model, say one for a reed instrument. One is then however also often somewhat restricted by the special properties of the family of instruments that driver model tries to emulate. A model for blowing a pipe does not understand how things behave when they are plucked, etc.

The WSA however scores in overall flexibility by giving the user an immense range of possibilities and permutations. Basically the resonator modeling section could be seen as one, completely open, tone shaping model (which is the reason why we called it section 2A). One can freely combine all elements in this model and since the ROM-set is as broad as that of any workstation one is spoiled for choice anyway.

The only real letdowns are:

- Since the drivers are not modeled the WSA is not as detailed in its phrasing behavior as other, purer physical modeling synthesizers. So if you, for instance, want to overblow a trumpet sound like a real jazz player can, you’d better turn to a “real” modeling synthesizer.
- The concept is not implemented with total logic. If the acoustic body is added in the modeling section, why then do so many sounds in the sample ROM already have their own bodies sampled into them? A string orchestra sample, for instance, does not only already include the bodies of all its individual instruments but even the character of the overall acoustic space in which it is recorded.

Of course the ultimate modeling synthesizer should have separate models for drivers and resonators alike, which could then be combined just as freely as samples and resonator models are in the WSA. In reality these limitations and inconsistencies are however a very small price to pay! Instead of having to take control of another huge set of modeling parameters for the drivers one starts with clearly defined, recognizable samples. Musing too much over inconsistencies can therefore become a bit counterproductive. It’s better to look at this solution as providing the best of both worlds (sampling realism and modeling flexibility) in one neat package.

By the way: The more complex samples are often actually great starting points for complex and evolving sounds!

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