

Procedural Audio Challenges & Opportunities

GDC 2011 – Audio Boot Camp

Nicolas Fournel – Principal Audio Programmer

Sony Computer Entertainment Europe



Worldwide Studios
Creative Services Group



Overview

- What is it ?
- What are the opportunities ?
- What are the challenges ?
- How can we deal with them?



Worldwide Studios
Creative Services Group



What is Procedural Audio ?

Generation of audio assets at run-time with a model
Using parameters coming from the game engine

For the 3 main areas of game audio:

- Sound effects: real-time sound synthesis (e.g. SoundSeed)
- Dialogue: speech synthesis (e.g. Phonetic Arts)
- Music: algorithmic composition



What is Procedural Audio ?

It's all about creating **asset models** rather than assets:

- sfx synthesis model
- voice model
- composer / piece model

In some regards, similar to 3D models in graphics



Worldwide Studios
Creative Services Group



Opportunities

- Fight repetition (e.g. footsteps, impacts)
- Reduce memory footprint (e.g. wind, ocean waves)
- Have more control:
 - evolving sounds (e.g. car engine, creature vocalizations)
 - better response to physics (e.g. rolling, sliding, scraping)
 - better response to motion controllers (e.g. whooshes)



Opportunities

Procedural audio can also be used when:

- It's impossible to generate all the assets
 - vast universe
 - too many combinations
- Requirements are only known at run time
 - sounds generation based on user-defined content



Challenges

- It is harder to implement than sample playback
 - CPU cost higher and/or non linear
 - requires low level DSP programming
 - must interface more closely with other subsystems
- It is harder to debug
 - more complex, more sources of bugs
 - harder to pinpoint what's going wrong

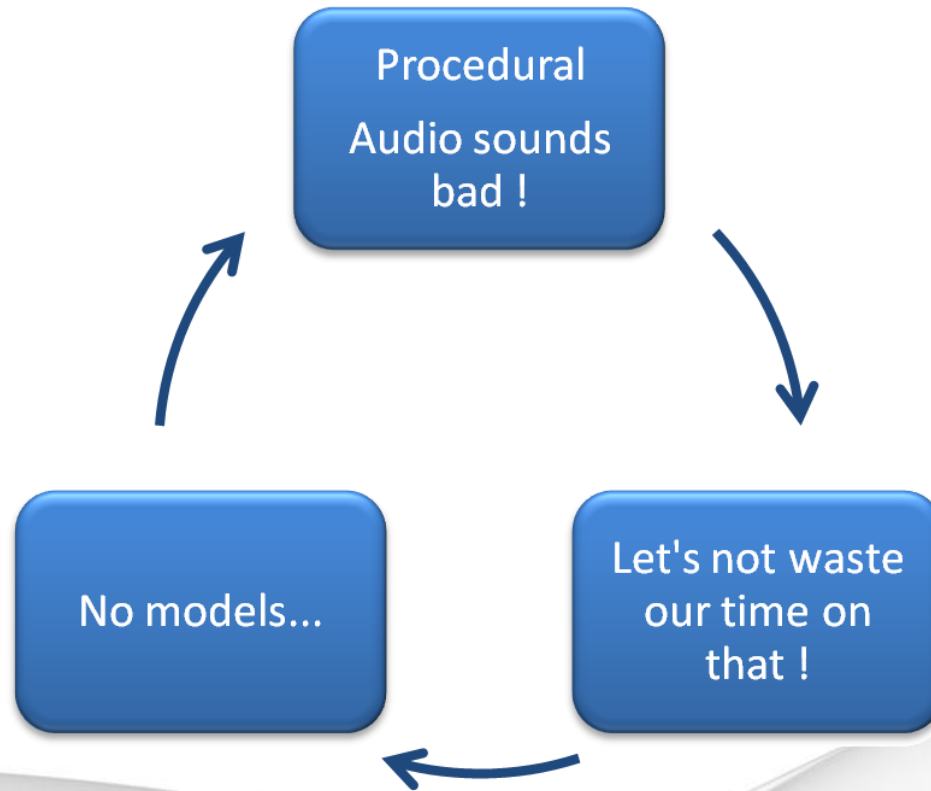


Challenges

- Pipelines are not ready. Mostly due to lack of:
 - trained sound designers / programmers / testers
 - adapted tools / run-time
 - ready-to-use models:
 - don't know how to do it !
 - results not “convincing” enough
 - not enough time to research the model
 - no collaboration within the industry



Lack of models : a vicious circle



Where can we get models ?

Ready to use Procedural Audio models:

- easy to use but...
- limited to available models from the developer
- limited to what parameters they allow
- limited to the idea the creator of the model has of the sound

Examples:

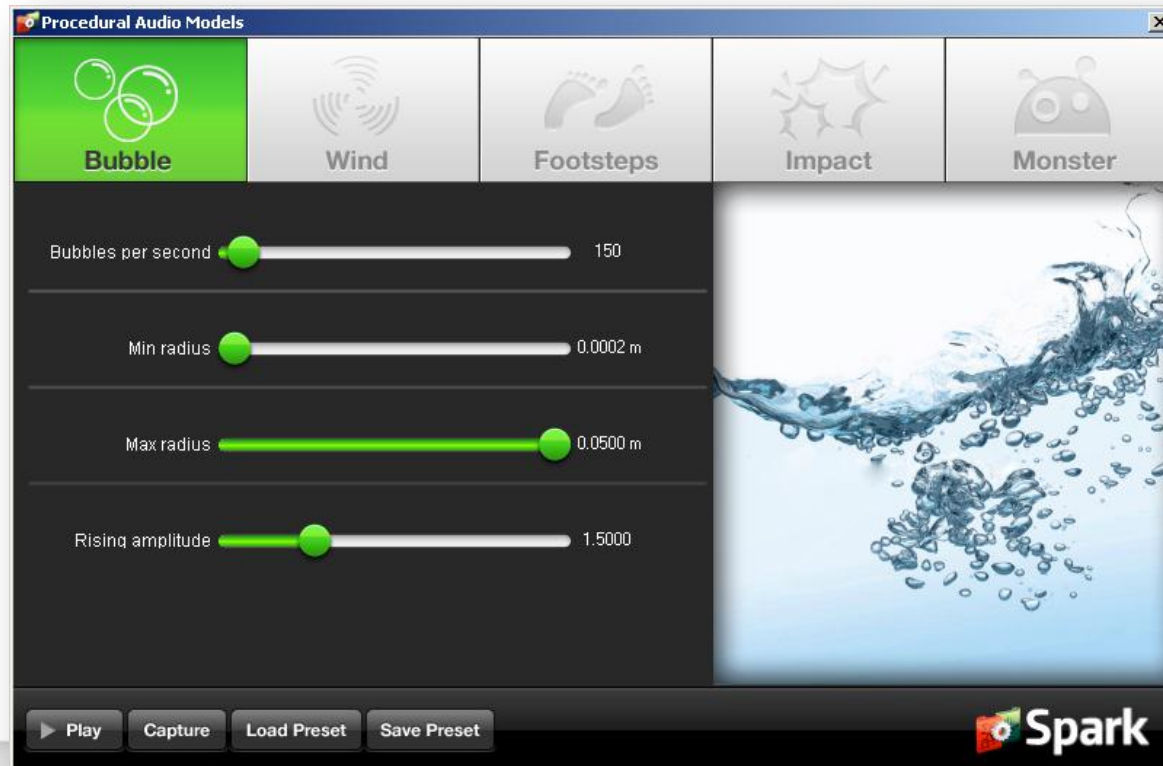
- Staccato Systems already in 2000...
- WWISE SoundSeed series
- your audio programmer's brain



Worldwide Studios
Creative Services Group



Demo: Spark



Worldwide Studios
Creative Services Group

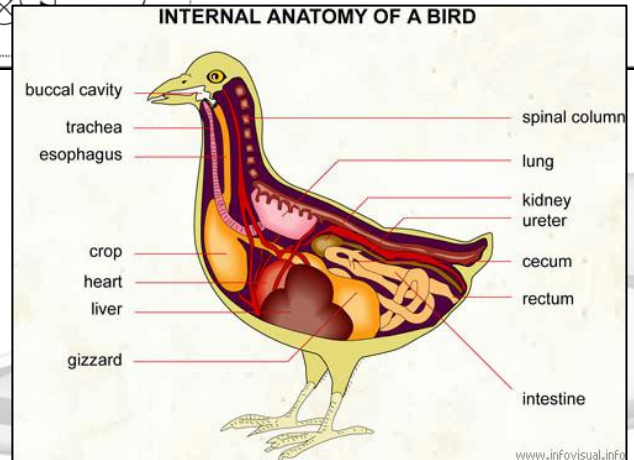
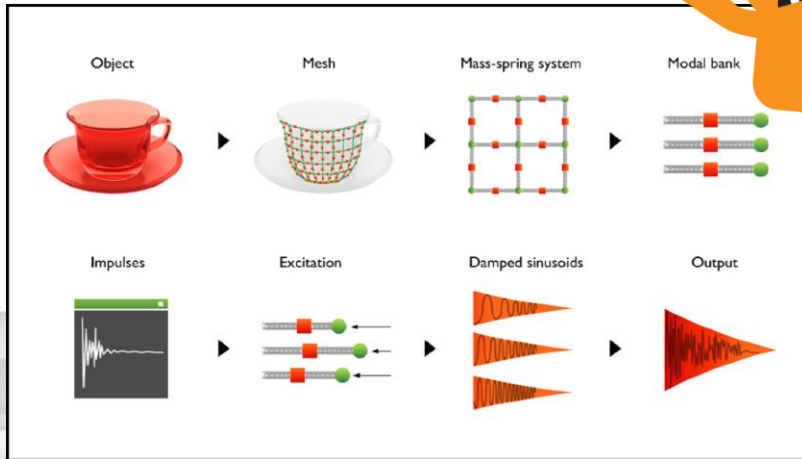
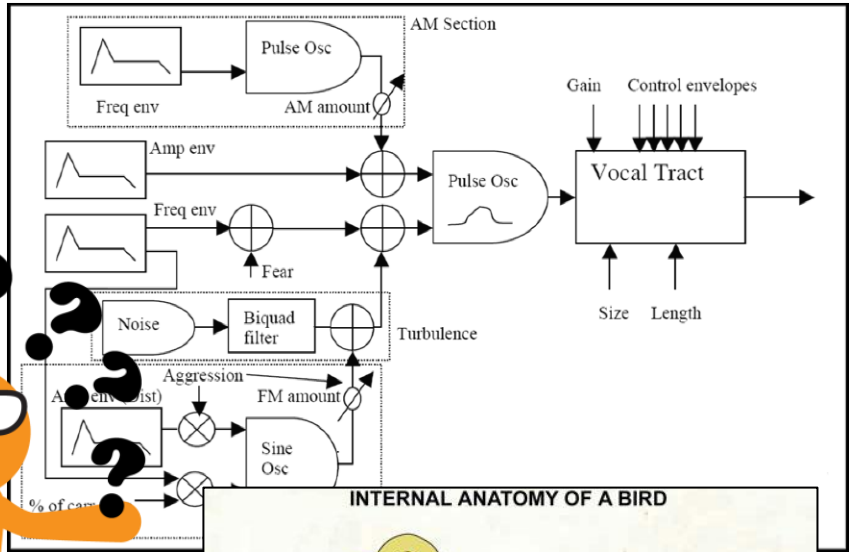
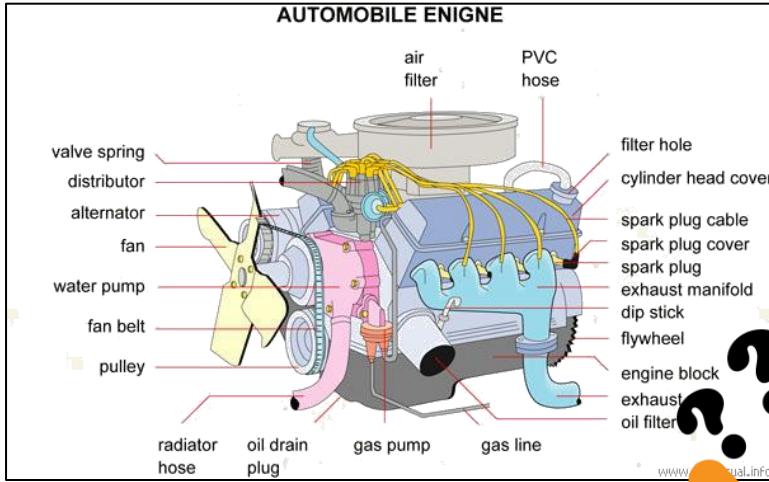


Implementation with Patching

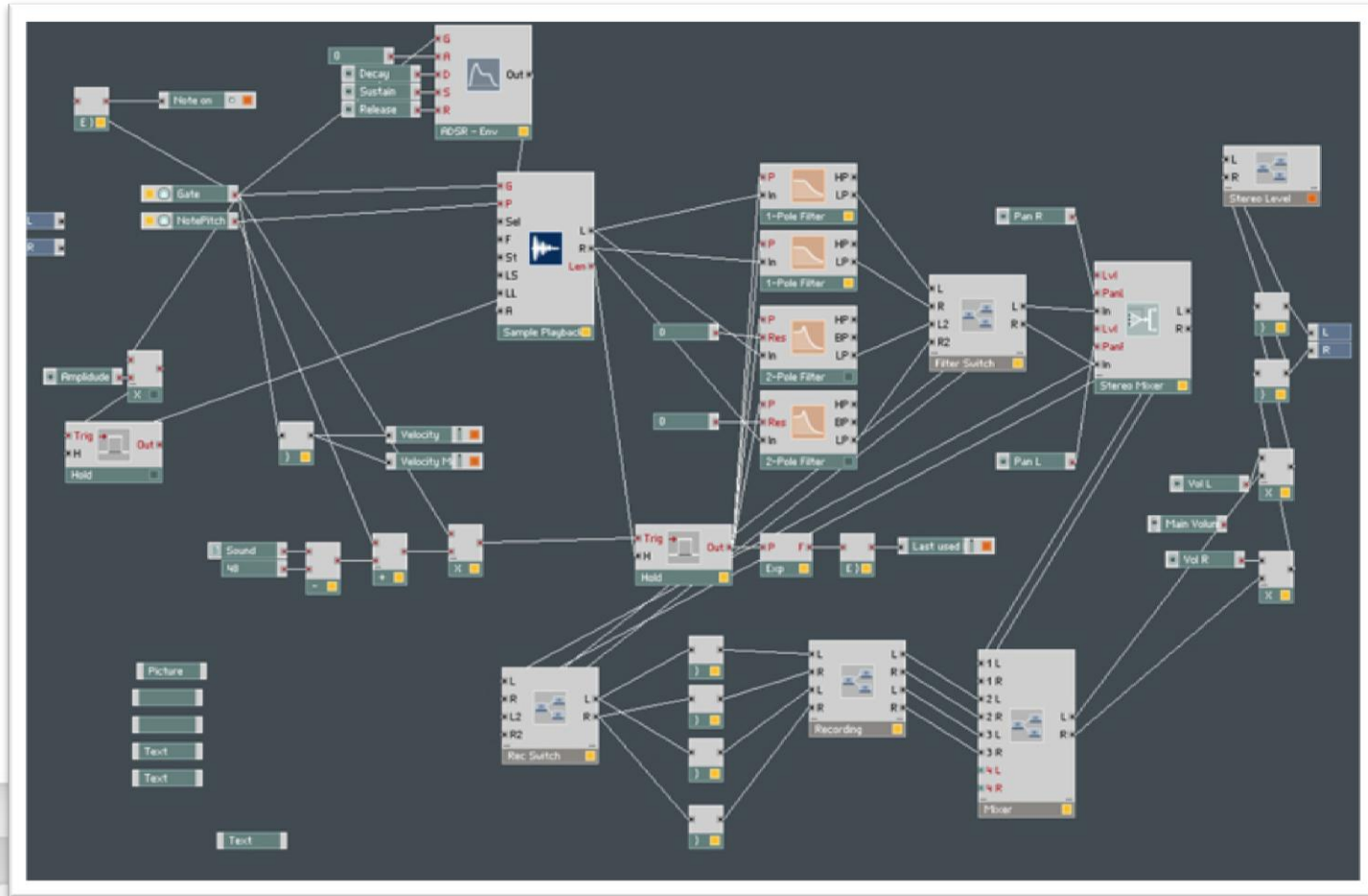
- Tools such as Pure Data / MAX MSP / Reaktor
- Sometimes hard to understand and inefficient due to the granularity of operators
- Bottom -up approach
- Requires knowledge in audio synthesis, mechanics, animal anatomy, physics etc...



Sound Design 101



A “simple” patch in Reaktor...



Worldwide Studios
Creative Services Group



Another Approach ?

Model used by Sound Designer



Creation of Model



Research of Audio Production Mechanisms

Static Samples provided by Sound Designer



Audio Analysis



Generation of Dynamic Model

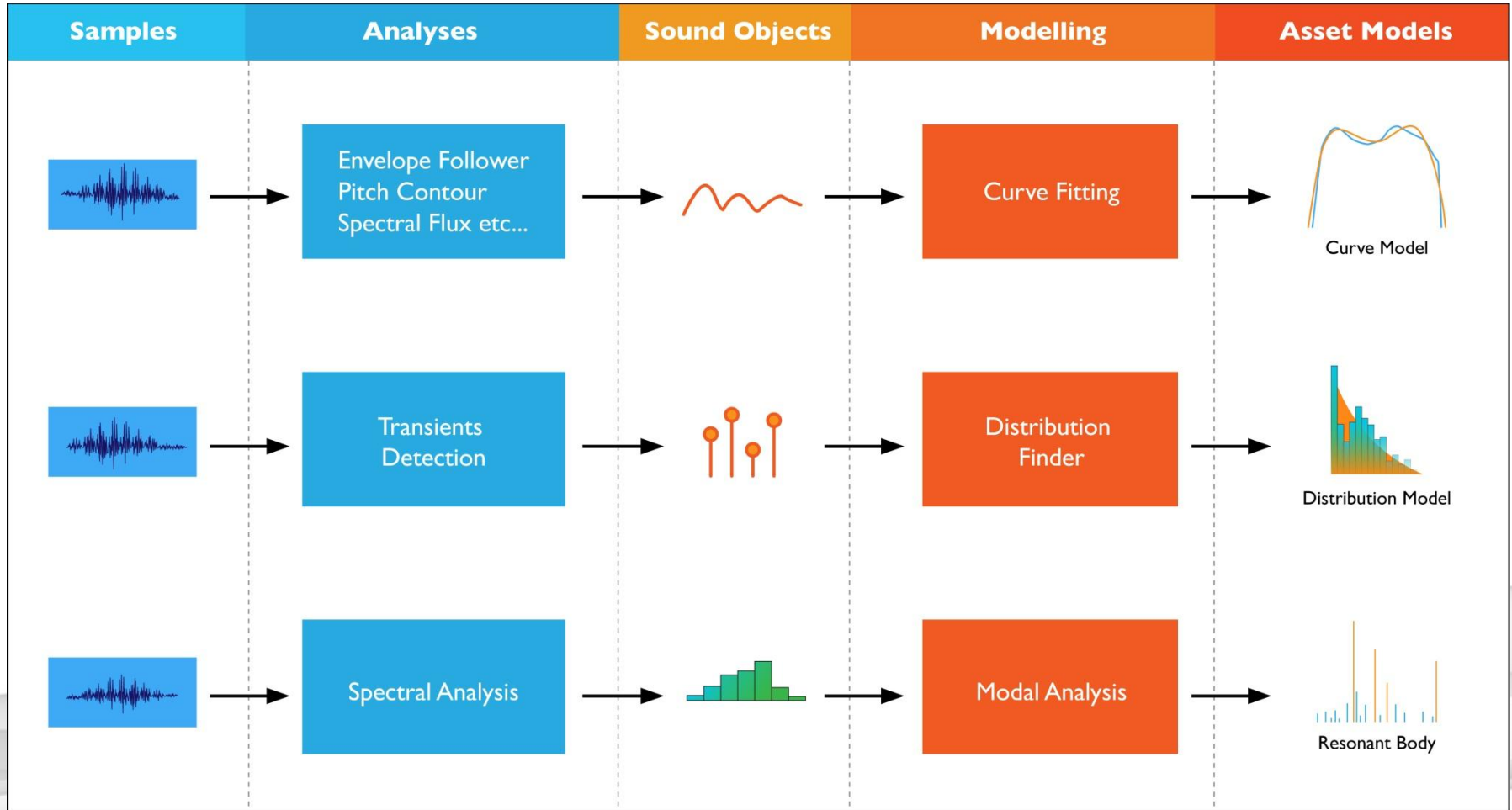


The top-down approach...

- allows the sound designer to create a dynamic model from a static sound
- without having an extensive knowledge of synthesis / sound production mechanisms
- without having to rely on third party models
- what makes it possible is...



Audio Analysis



Because we are using analysis...

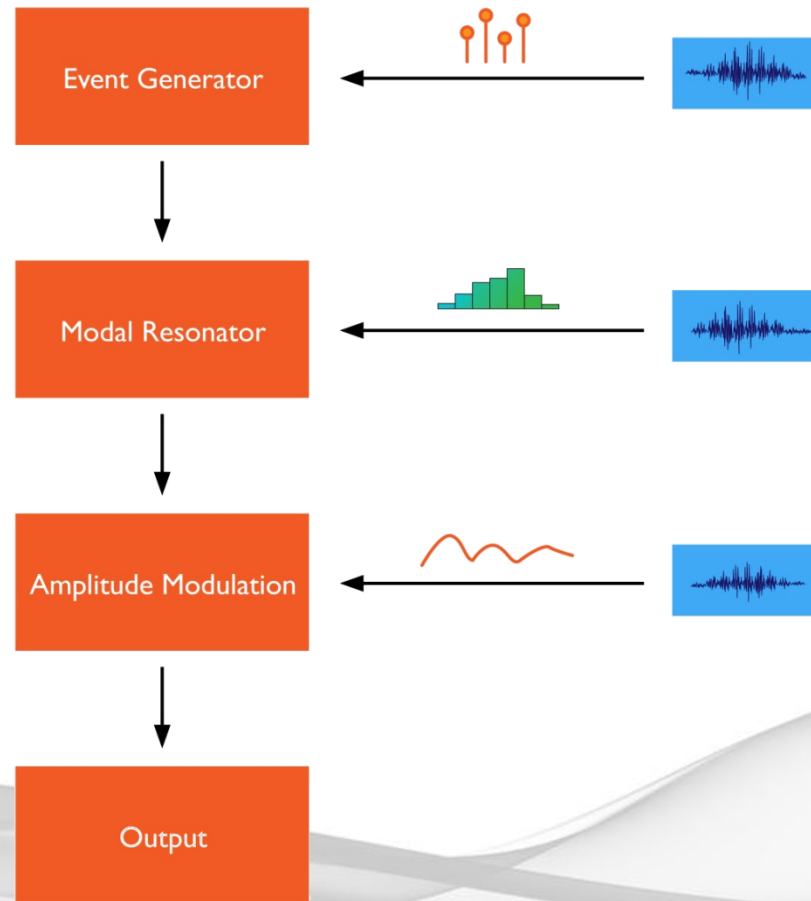
- We can use our own sounds as basis for a model
- The modules can implement more complex behaviours
- We can have a smaller number of modules (solves issues related to granularity)



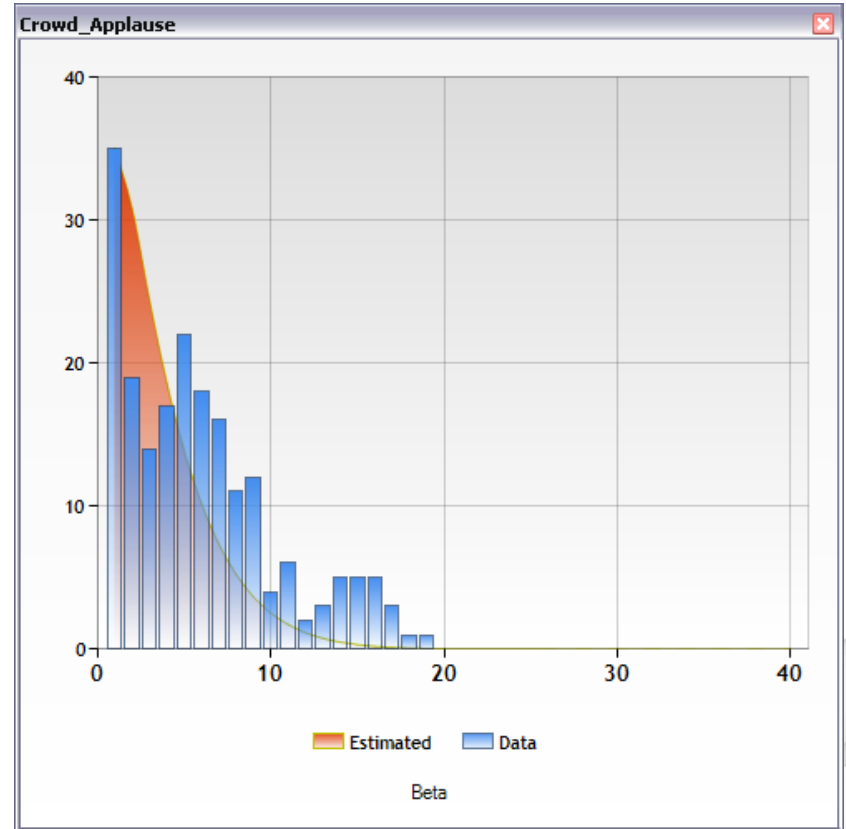
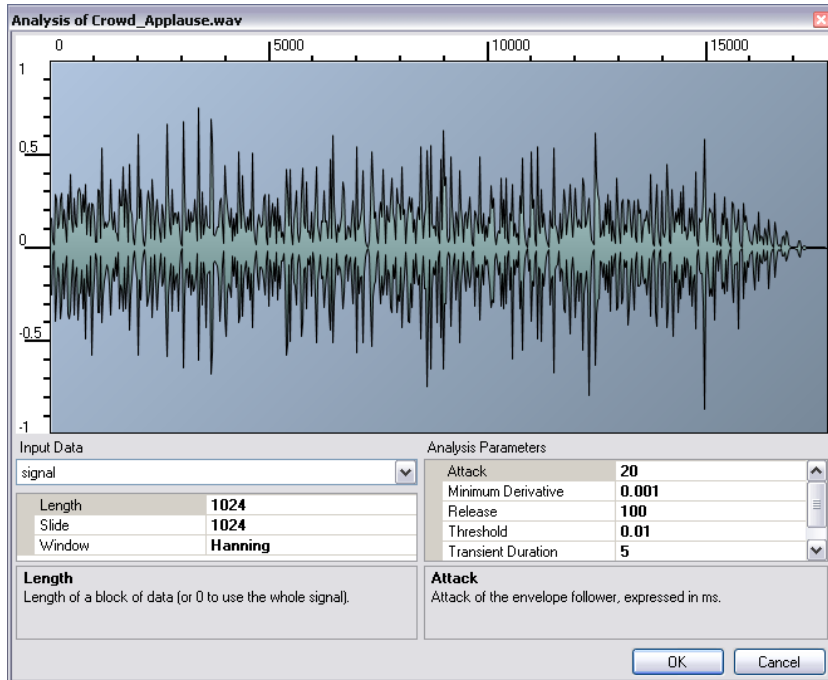
Worldwide Studios
Creative Services Group



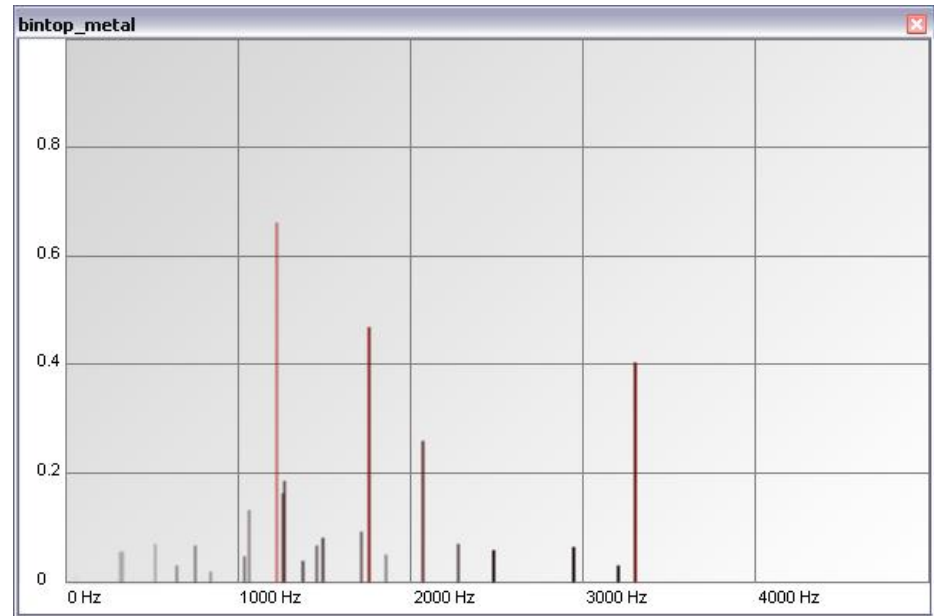
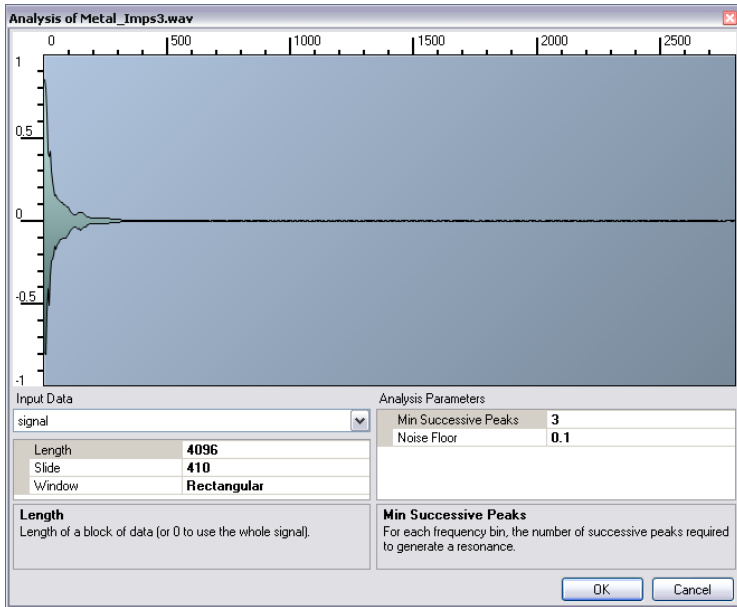
Example: debris / impacts



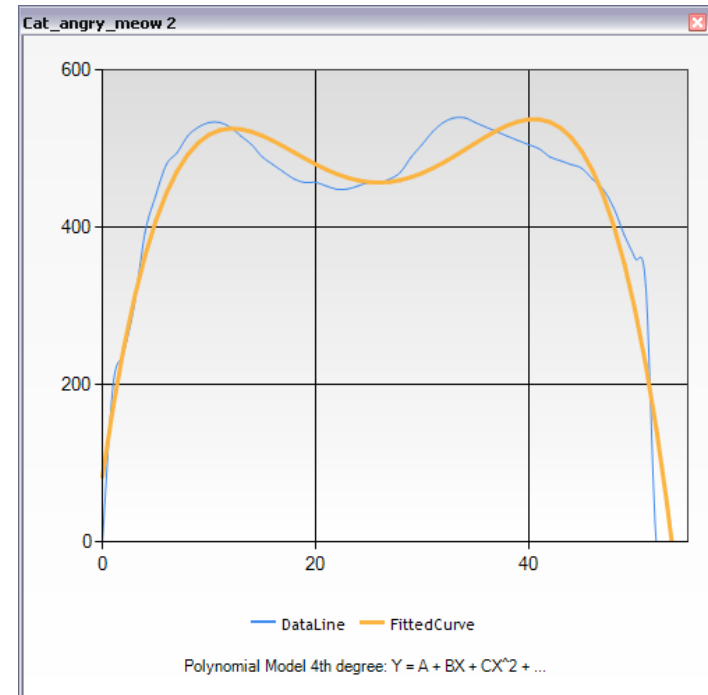
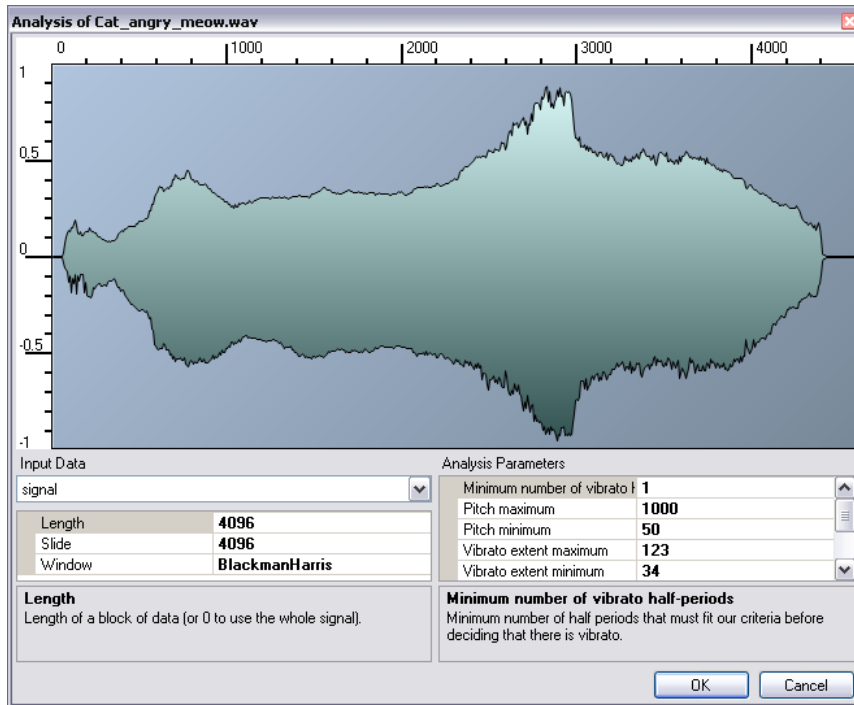
1 - Distribution Model



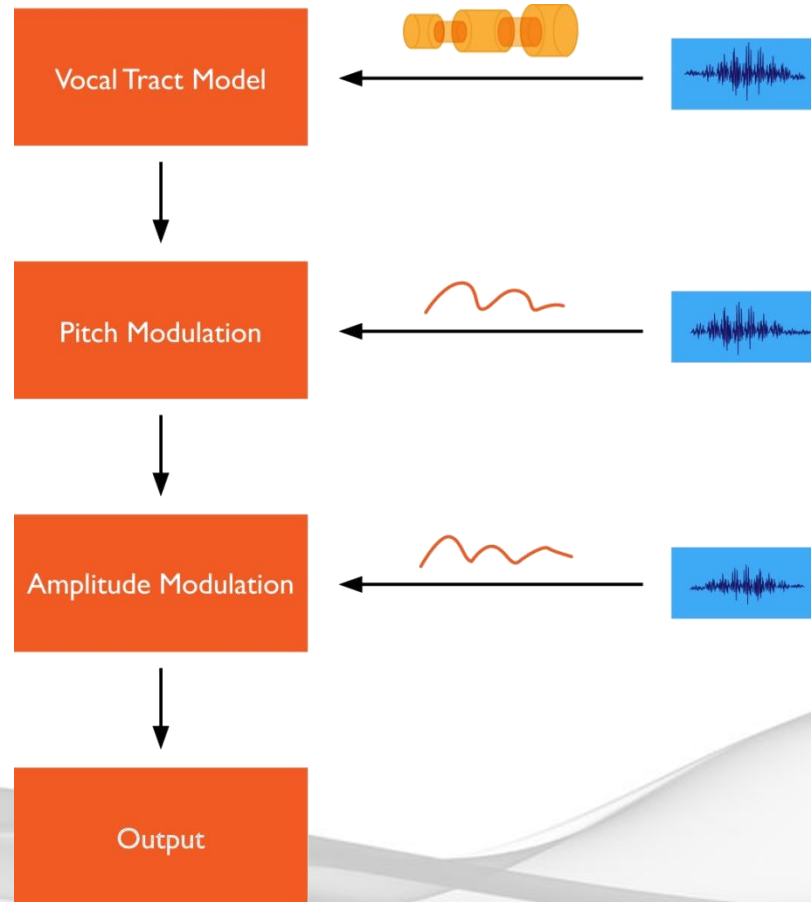
2 - Impact Model



3 - Curve Model



Creature Vocalisations



Demo: Spark Tool

The screenshot displays the Spark Tool interface, which is organized into several sections:

- Logic:** Contains an **Event Generator** block.
- Audio:** Contains blocks for **A.M.**, **Filter**, and **Mixer**.
- Generators:** Contains **Modal Resonator** blocks.

The main workspace shows a logic diagram with the following components and connections:

- Start** (Trigger) block connected to the **Trigger** input of a **Modal Resonator** block.
- The **Modal Resonator** block has **Damping** and **Pitch** inputs.
- The **Modal Resonator** block's **Audio** output is connected to an **Output** block.

At the top, the **Excitation** tab is active, showing four material options: **Glass_Impacts2**, **Wood_hit1**, **Metal_Imps3**, and **Gravel1**. A frequency spectrum graph on the right shows the output of the selected material, with a **Selection Mode** set to **Random**. Below the graph, the **Polyphony** settings are:

- Max number of voices: **10**
- Mode: **RejectNew**

The **Parameters** section includes:

- Amplitude variation: **0**
- Damping scale: **1**
- Damping variation: **0**
- Max number of modes: **100**
- Modes variation %: **0**
- Pitch scale: **1**



Worldwide Studios
Creative Services Group



Conclusion: it's all about the models

We need better ways to create them:

- from the designer's sound (top - down approach)
- using better tools (importance of audio features extraction)
- while educating teams across disciplines

To progress, we also need:

- a game industry procedural audio working group
- more collaboration with academia
- to share models across the industry





Thank you!

Any questions?

Email: nicolasfournel@yahoo.com

Twitter: @nicolasfournel



Worldwide Studios
Creative Services Group

