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Audio on the Web (a brief history)

Michel Buffa

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Audio on the Web (a brief history)

Sound and Music Computing 2022

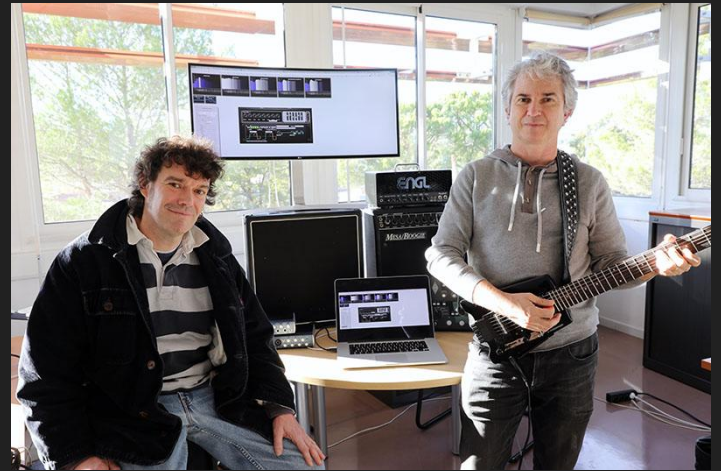
11 June 2022

Michel Buffa,
Université Côte d'Azur, France,
I3S/CNRS/INRIA labs
buffa@i3s.unice.fr, @micbuffa



Who am I?

- Professor / researcher at Université Côte d'Azur, in the South of France
 - Member of the WIMMICS research group common to INRIA and I3S lab from CNRS
 - W3C Advisory Committee Representative for UCA
- I participate to W3C working groups (HTML5, WebAudio...)
- I'm the co-creator of the Web Audio Modules 2.0 (WAM or WAM2), aka VSTs for the Web.
- Some WebAudio plugins I wrote are now commercialized by CNRS (tube guitar amplifier simulators + audio FXs)




Before 1996
we barely could hear
any sound from a browser

← → ↻ ⌂ Non sécurisé | users.polytech.unice.fr/~buffa/

Applications 10 of the best way... Get started | Lear... Zenodo (88) SMC-22 Live... Audit Qualiopi - 2... Demo audio - Goo... Rapport CSI - Goo... Thèse Maroua Tik... Mé

Welcome to Michel's home page!

buffa@unice.fr



[Who am I? What is my work...](#)
[My coordinates](#)
[My hobbies](#)
[My courses](#)

You want to see me live? Check [this funny anim](#) and also [this new one!](#)

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- [Internet, WWW, etc...](#)
- [Teaching computer techniques, University of Nice related stuff](#)
- [Research centers I have worked with](#)
- [Culture...](#)
- [Unix related stuff, X11/Motif/Tk, ftp, fsp, etc...](#)
- [Virtual Reality/3D/Computer Graphics](#)
- [Dictionnaires, maps, etc...](#)
- [Interesting personal Home Pages](#)
- [Pure Fun](#)
- [Buisness WWW sites](#)

← → ↻ ⌂ Non sécurisé | users.polytech.unice.fr/~buffa/#courses

Applications 10 of the best way... Get started | Lear... Zenodo (88) SMC-22 Live... A

My courses

- [Computer Graphics and OpenGL Programming](#)
- [Internet and WWW](#)
- [Java](#)
- [X11 and Motif Programming](#)
- [VRML](#)
- [Zsh](#)
- [An old WWW tutorial I wrote in 1994](#)
- [others...](#)

Created in 1993, last updated:1996, HTML 1

After 1996

Horrors and Joys

The infamous `<bgsound>` tag from IE4! (1996)

HTML `<bgsound>` tag

please plugin speaker/headphone to listen to the sound.

Supported Browsers: The supported browsers by HTML | `<bgsound>` tag are listed below:

- Internet Explorer

...also known as the worst possible way to use audio on the web!



I assume you are using the `bgsound` tag.



0

Sign
in to
vote

The `bgsound` tag is non-standard and IE-specific. Firefox does not support it.

I would strongly suggest that you do not use a background sound, unless this is a personal/family site where your friends and family know what to expect.

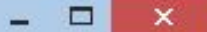
As a rule, visitors do not appreciate their family, co-workers, other coffee shop patrons, or sleeping babies being blasted with sound from their computer that they had no control over.

If you want to play sound, do it with a method that lets the visitor control starting it and stopping it; don't try to do it automatically.




 <http://www.jw.org/download/?output=html>  

 [jw.org](http://www.jw.org) 



Jehovah's Witnesses—Organized to Share the Good News

Error loading media:
File could not be played 

However, with a little struggle, we had great applications!



FXExperiencePlayer / Java FX (video from 2012)



Audiotools / Flash (video from 2013)

1996-2011



 dreamstime.com

ID 154897294 © Vasilyrosca

2008-2010: HTML5 audio tag with rather complete JavaScript API

ANOTHER CODEC WAR, until 2015
no way to play a mp3 on all major browsers!

HTML `<audio>`



```
<audio controls>  
  <source src="sound.ogg" type="audio/ogg">  
  <source src="sound.mp3" type="audio/mpeg">  
  Your browser does not support the audio tag.  
</audio>
```



 samanthaming

samanthaming.com

 samantha_ming

For serious audio applications: Flash or Die!



Soundation



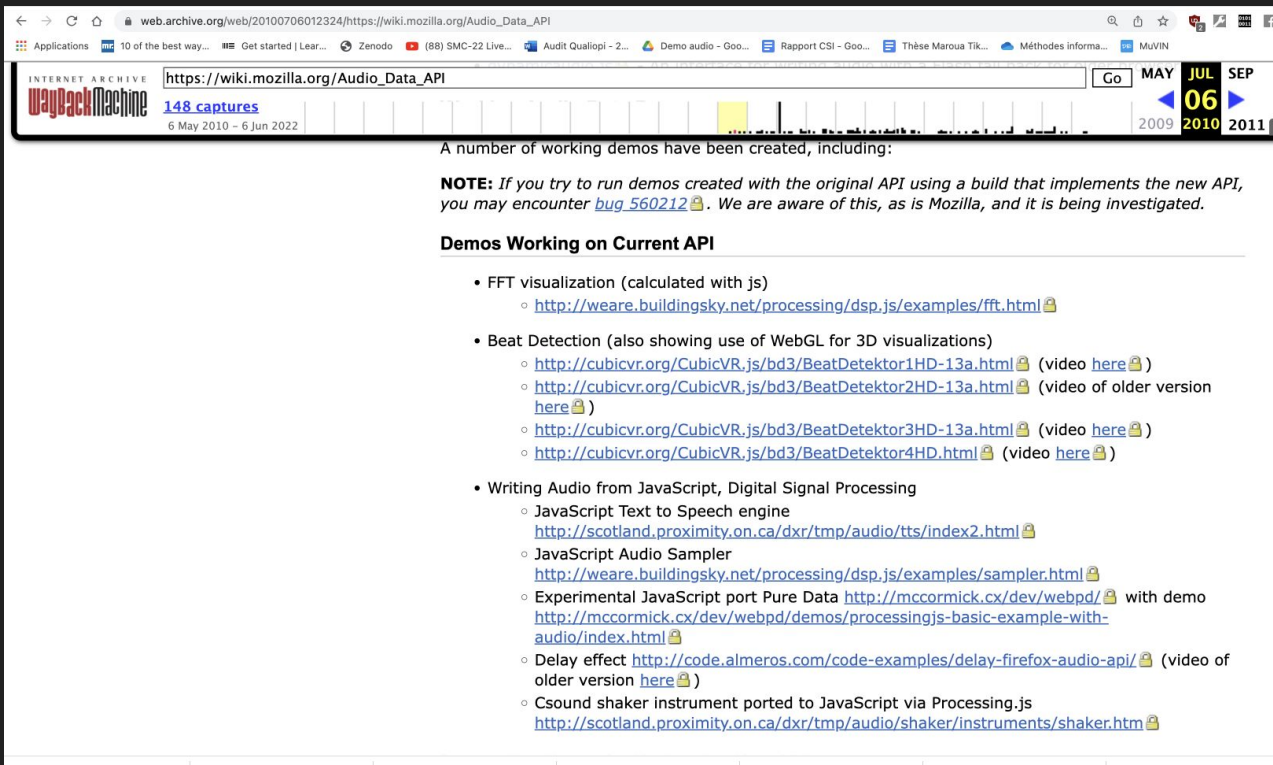
Audio Sauna

2010

First browser APIs
for audio processing

Firefox Audio Data API (2010)

Simple: nearly no native code in the browser, all sound processing delegated to JavaScript, short spec!



INTERNET ARCHIVE
waybackmachine

148 captures
6 May 2010 - 6 Jun 2022

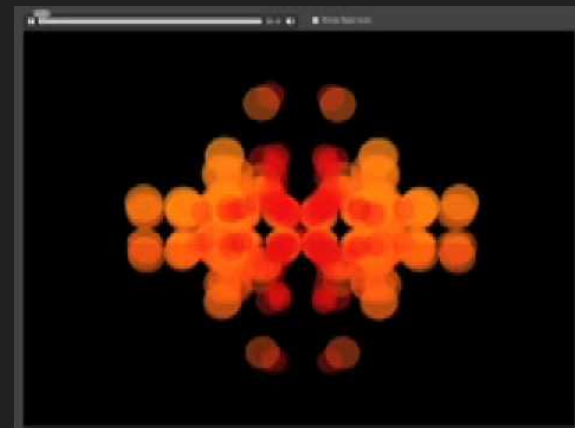
Go MAY JUL SEP
06
2009 2010 2011

A number of working demos have been created, including:

NOTE: *If you try to run demos created with the original API using a build that implements the new API, you may encounter [bug 560212](#). We are aware of this, as is Mozilla, and it is being investigated.*

Demos Working on Current API

- FFT visualization (calculated with js)
 - <http://weare.buildingsky.net/processing/dsp.js/examples/fft.html>
- Beat Detection (also showing use of WebGL for 3D visualizations)
 - <http://cubicvr.org/CubicVR.js/bd3/BeatDetektor1HD-13a.html> (video [here](#))
 - <http://cubicvr.org/CubicVR.js/bd3/BeatDetektor2HD-13a.html> (video of older version [here](#))
 - <http://cubicvr.org/CubicVR.js/bd3/BeatDetektor3HD-13a.html> (video [here](#))
 - <http://cubicvr.org/CubicVR.js/bd3/BeatDetektor4HD.html> (video [here](#))
- Writing Audio from JavaScript, Digital Signal Processing
 - JavaScript Text to Speech engine
<http://scotland.proximity.on.ca/dxr/tmp/audio/tts/index2.html>
 - JavaScript Audio Sampler
<http://weare.buildingsky.net/processing/dsp.js/examples/sampler.html>
 - Experimental JavaScript port Pure Data <http://mccormick.cx/dev/webpd/> with demo <http://mccormick.cx/dev/webpd/demos/processingjs-basic-example-with-audio/index.html>
 - Delay effect <http://code.almeros.com/code-examples/delay-firefox-audio-api/> (video of older version [here](#))
 - Csound shaker instrument ported to JavaScript via Processing.js
<http://scotland.proximity.on.ca/dxr/tmp/audio/shaker/instruments/shaker.htm>



The W

Proposed b

lists.w3.org/Archiv

Applications 10 of the best way...

[W3C home](#) > [Mailing lists](#)

Web Audio API

This message: [[M](#)]
[Related messages](#)

From: Chris Rogers <crogers@chromium.org>
Date: Mon, 14 Jun 2010 10:00:00
Message-ID: <AANLkTik69Rr-...>
To: public-xg-audio@w3.org

Hi Everyone,

Since it looks like there is
this opportunity to improve
developing over the past few
at Google as part of the
at Apple as an engineer

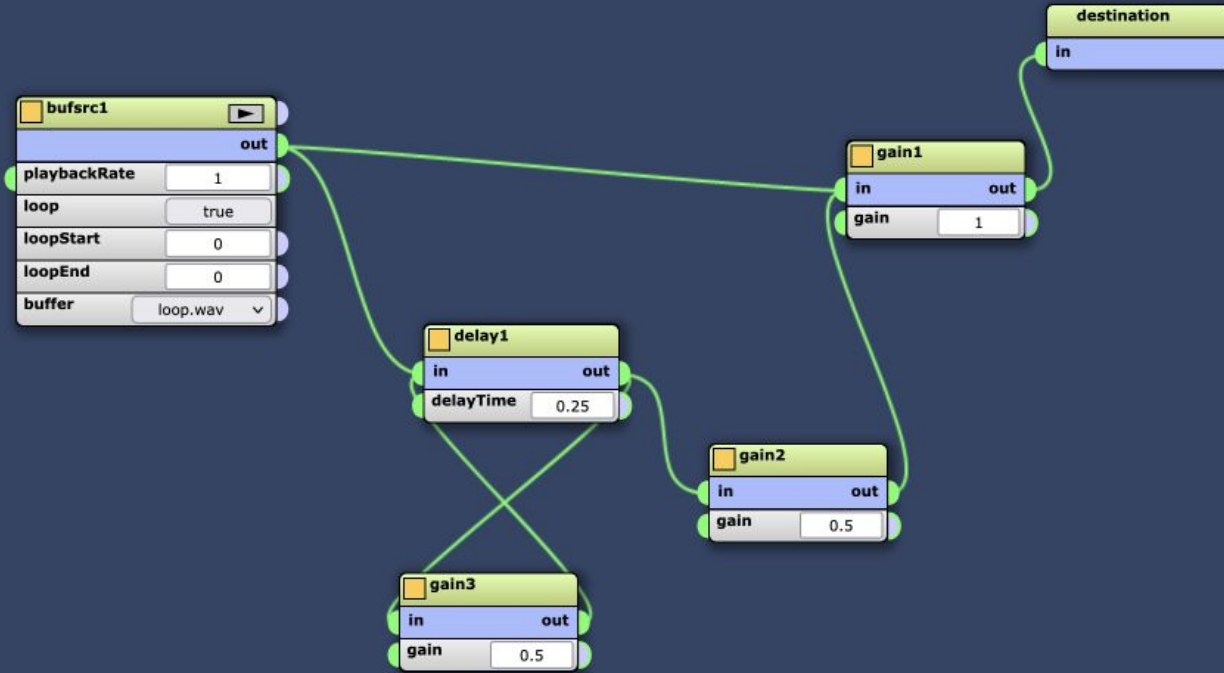
I've been developing a
<https://svn.webkit.org>
(most of the interest)

I've been working with
Carlson, Chris Marrin,
API to the point where
group. Here's a prelimi

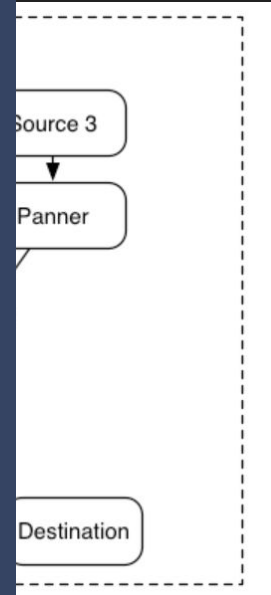
<http://chromium.google>

WebAudio Designer <https://github.com/g200kg/webaudiodesigner>

Stop Graph Add Node Add Controller About



DSP part

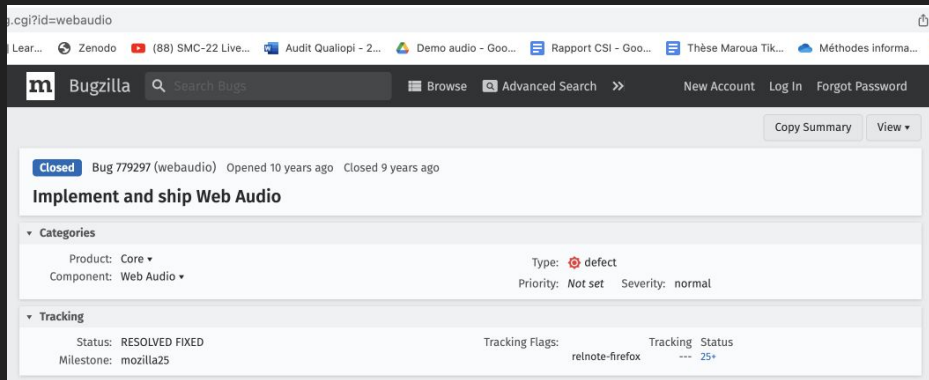
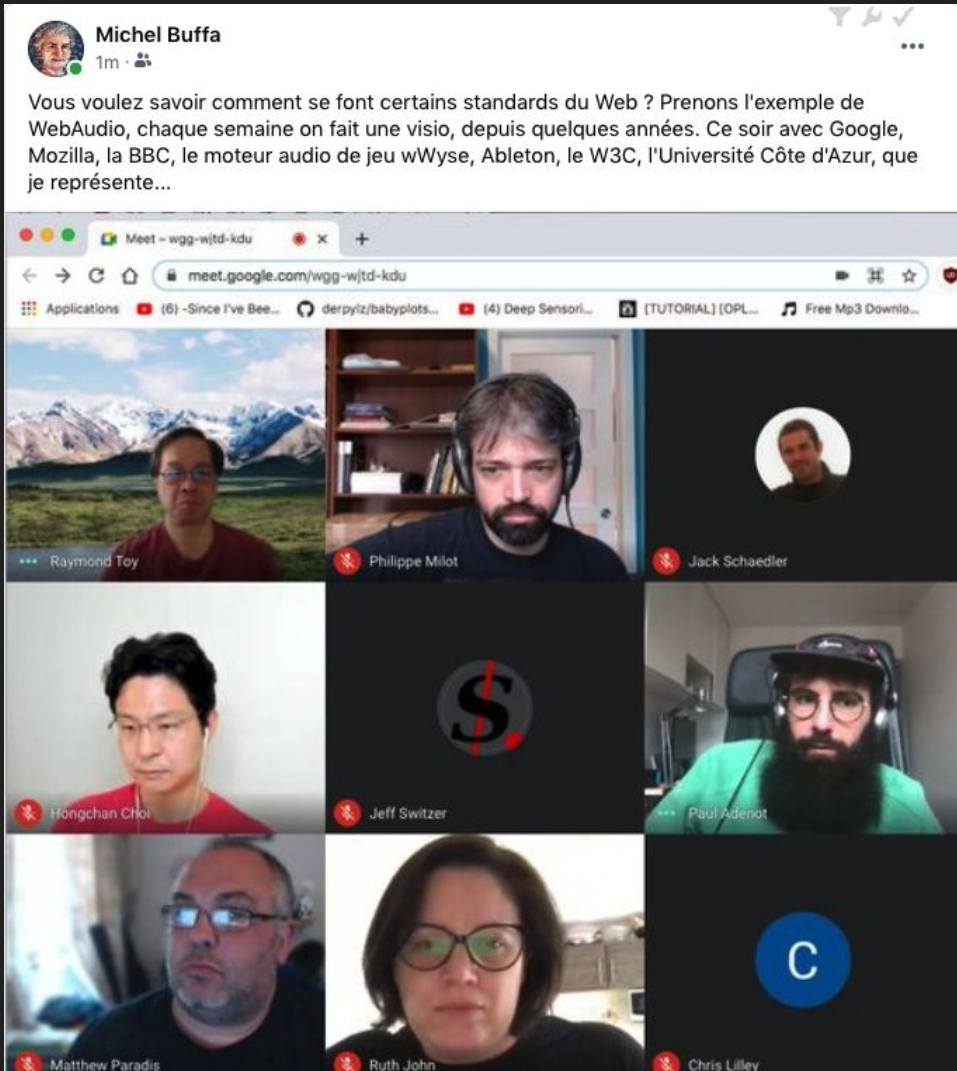


Creation of a W3C Web Audio Working Group

Meeting every 1-2 weeks

In person meeting 2-3 times a year

(right picture from 2021)



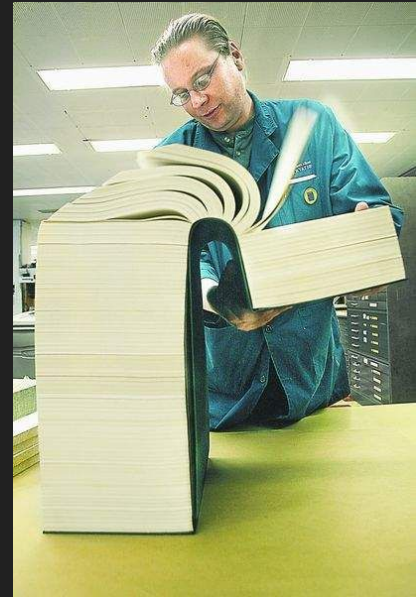
Some milestones

15/12/2011: first draft specification of the [WebAudio API](#)

- Lot of work to make sure it can be implemented and sound the same on all browsers (algorithms, etc.)

2012:

- Implementations in Firefox/Webkit browsers
- Support for real time input: [Media Capture and Streams API](#)
- First draft of the [WebMidi API](#), implementation in Google Chrome
 - (2022 in Firefox too!)



But... porting existing DSP code was not easy...

The WebAudio API was incomplete!

Need for something better!

Monster Madness – creating games on the web with Emscripten



By [Jeremy Stieglitz](#), [Robert Nyman](#) [Editor emeritus]

Posted on December 12, 2013 [asm.js](#), [Audio](#), [Games](#), [IndexedDB](#), and [WebRTC](#)

When our engineering teams at Trendy Entertainment & Nom Nom Games decided on the strategy of developing one of our new Unreal Engine 3 games — [Monster Madness Online](#) — as a cross-platform title, we knew that a frictionless multiplayer web browser version would be central to this experience. The big question, however, was determining what essential technologies to utilize in order to bring our game onto the web. As a C++ oriented developer, we determined quickly that rewriting the game engine from the ground-up was out of the question. We'd need a solution that would allow us to port our existing code in an efficient manner into a format usable in the browser...

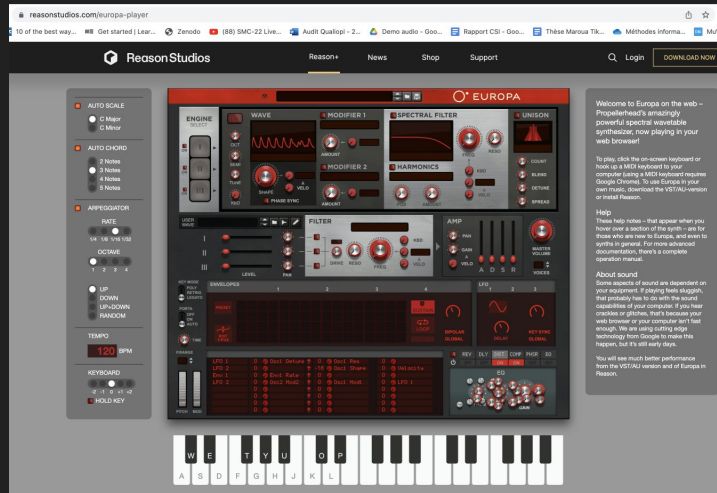
TL;DR? Watch the video!

IT DID NOT WORK WELL !!!!!



Some milestones

2018-2022: [AudioWorklet](#) : custom DSP processing in the Audio Thread



2012 : WebSockets (synchronous collaboration)

2015: Web Components

2018: WebAssembly

Recent history...

2021: the WebAudio API V 1.0 [became a W3C Recommendation in June 2021](#)
(aka a “frozen standard”)

2021-today : ongoing development of Version 2.0

- The working group took care of [github issues/proposals](#)
- [Conducted a developers' survey](#)

2022 : W3C proposes help for higher level standards (i.e for a plugin standard)



Some notable demos

Web Audio Demos

[Playground \(a,i\)](#)

The Web Audio Playground helps developers visualize how the graph nodes in the Web Audio API work. Shown at I/O 2012.

[Vocoder \(a,i,m\)](#)

This complex audio processing app (shown at I/O 2012) implements a 28-band [vocoder](#) - a "robotic voice" processor.

["Analog" Synth \(a,m\)](#)

This application implements a polyphonic "analog" synthesizer, with a classic voice architecture. Playable via Web MIDI or onscreen keyboard.

[Input Effects \(a,i\)](#)

This demo lets you play with a few common effects on the audio inputs.

[AudioRecorder \(a,i\)](#)

This is sample code for recording audio from live input and downloading them as WAV files, built on Matt Diamond's excellent [RecorderJS](#).

[Oscilloscope \(a\)](#)

Oscilloscope waveform display for Web Audio, and pulse-width duty cycle control on a square wave.

[Monosynth \(a,m\)](#)

Example of a monophonic Web MIDI/Web Audio synth, with no UI.

[wubwubwub \(a,m\)](#)

This application implements a dual DJ deck, specifically intended to be driven by a Numark MIDI controller.

[Pitch Detection \(i\)](#)

This application performs monophonic autocorrelating pitch detection in realtime. This is suitable for a guitar tuner or other complex waveform source.

[The Game of Life \(m\)](#)

Conway's Game of Life, on an 8x8 grid, interfacing with a Novation Launchpad controller via Web MIDI.

[Happy Drums \(a,m\)](#)

Quick addition of MIDI controller support (using a Livid Instruments CNTRLR) to the [Shiny Drum Machine](#).

[TemplateSynth \(a,m\)](#)

Simple template for Web Audio synths, with a polyphonic voice architecture, on-screen keyboard (including touch), and Web MIDI.

[TouchPad \(a,t\)](#)

Pointer/multi-touch input to control Web Audio. Load it on a touch device, touch and slide around - to open/close the filter and modify Q.

[Volume Meter \(i\)](#)

This is a simple code example of how to properly implement a clip-detecting volume meter.

[Sampler \(a,m\)](#)

This is an in-progress example of how to implement a sample-playback synthesizer. Eventually should support looping and voice control, but simple code example of how to properly implement a clip-detecting volume meter.

[Slide Deck](#)

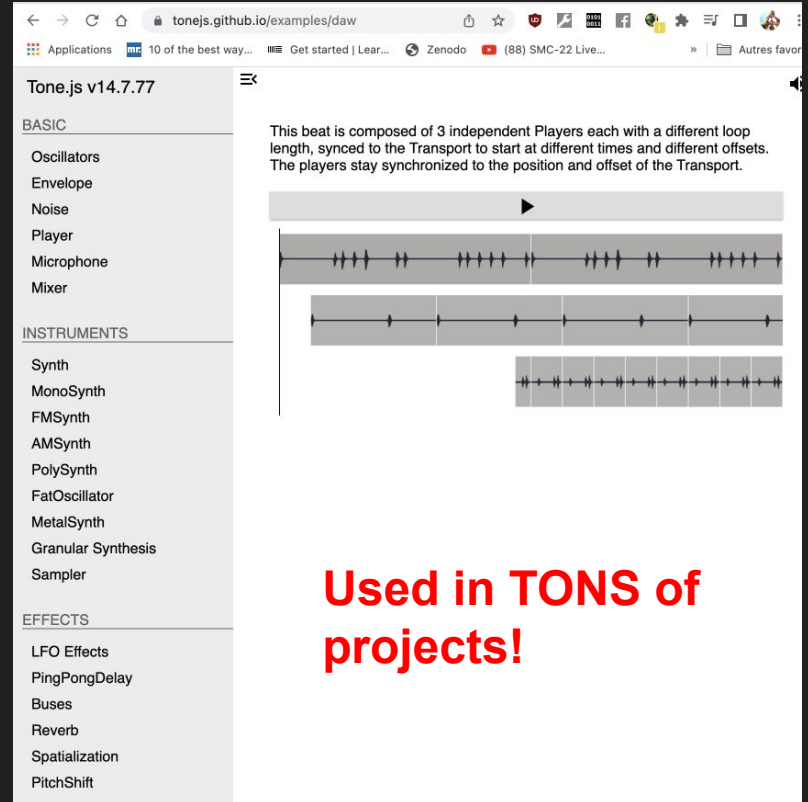
Slide deck on Web Audio and Web MIDI.

2011-2015: Chris Wilson's demos!

2014: first implementation of ToneJS library



The screenshot shows the web interface for the Tone.js v14.7.77 Pitch Shift example. The browser address bar displays 'tonejs.github.io/examples/pitchShift'. The interface is divided into a left sidebar and a main content area. The sidebar lists various modules under categories: BASIC (Oscillators, Envelope, Noise, Player, Microphone, Mixer), INSTRUMENTS (Synth, MonoSynth, FMSynth, AMSynth, PolySynth, FatOscillator, MetalSynth, Granular Synthesis, Sampler), EFFECTS (LFO Effects, PingPongDelay, Buses, Reverb, Spatialization, PitchShift), and SEQUENCING / TIMING (Step Sequencer). The main content area features a text description: 'This example demonstrates the Pitch Shift effect.' followed by a link to 'Tone.Pitch Shift docs.'. Below the text is a 'pitch' slider control set to '-0.03 hz' and a waveform visualization showing a signal with a slight pitch shift.



The screenshot shows the web interface for the Tone.js v14.7.77 DAW example. The browser address bar displays 'tonejs.github.io/examples/daw'. The interface is divided into a left sidebar and a main content area. The sidebar lists various modules under categories: BASIC (Oscillators, Envelope, Noise, Player, Microphone, Mixer), INSTRUMENTS (Synth, MonoSynth, FMSynth, AMSynth, PolySynth, FatOscillator, MetalSynth, Granular Synthesis, Sampler), and EFFECTS (LFO Effects, PingPongDelay, Buses, Reverb, Spatialization, PitchShift). The main content area features a text description: 'This beat is composed of 3 independent Players each with a different loop length, synced to the Transport to start at different times and different offsets. The players stay synchronized to the position and offset of the Transport.' Below the text is a visual representation of a beat with three overlapping waveforms, each with a different loop length and offset, demonstrating synchronization to the transport.

Used in TONS of projects!

2015: Web Audio debugger in Firefox

The screenshot displays the Firefox Web Audio debugger interface. The top navigation bar includes tabs for Inspector, Console, Debugger, Style Editor, and Web Audio. The main area shows an audio graph with the following nodes and connections:

- OscillatorNode** connects to **BiquadFilterNode** and **AudioDestinationNode**.
- AudioBufferSourceNode** connects to **DynamicsCompressorNode**.
- BiquadFilterNode** connects to **GainNode**.
- GainNode** connects to **AudioDestinationNode**.
- DynamicsCompressorNode** connects to **AudioDestinationNode**.

The **BiquadFilterNode** is highlighted in blue. The right-hand panel shows the **Parameters** for **BiquadFilterNode (conn0.audionode161)**:

Parameters	
▼ AudioParams	
type:	"highpass"
frequency:	1000
Q:	1
detune:	0
gain:	1

CATEGORY

- abstract (4)
- subtractive (2)
- additive (0)
- physical (0)
- sample (0)
- hybrid (0)
- misc (0)

WAM SYNTHS

WebAssembly / AudioWorklet

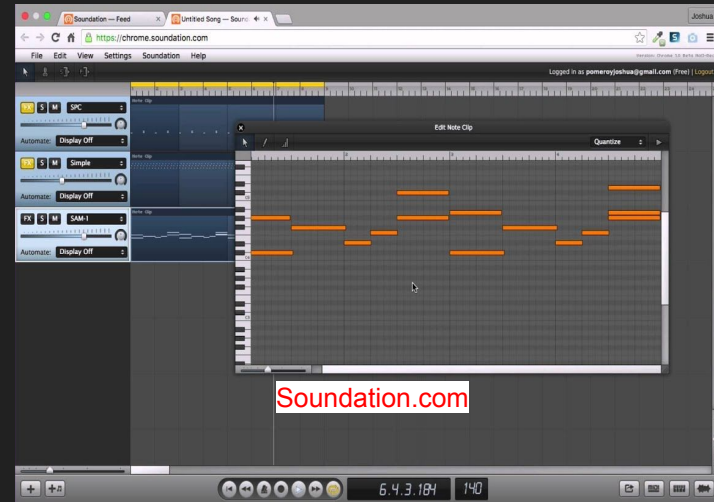
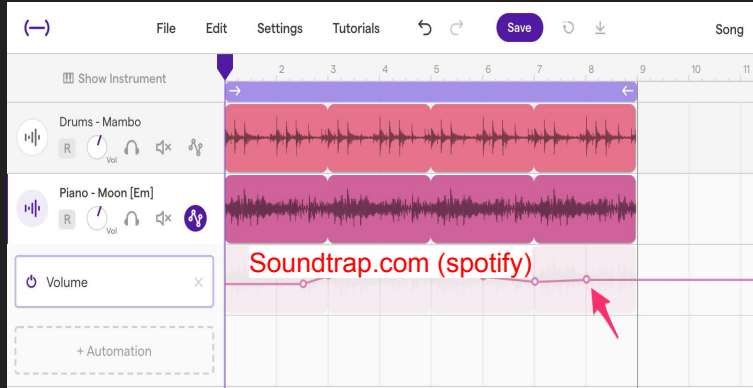


asm.js / ScriptProcessor



2015: Web Audio Modules (Kleimola & Larkin)

2015: first commercial DAWs



2016: why not some guitar?



2014/2015: DSLs compile to ASM.js and later to WebAssembly

FAUST, PureData, Csound, others can be run on the Web

2018 : FAUST online IDE

The screenshot displays the Faust online IDE interface. On the left, a file explorer lists various DSP modules, with 'ts9Anasound.dsp' selected. The main area shows the source code for 'ts9Anasound.dsp', which includes metadata like name, version, author, and license, followed by library imports and a 'preamp' function. Below the code editor, a 'GUI Builder' tab is active, showing a visual representation of the 'ts9Anasound' module. This GUI features a 'Tube Screamer' section with three knobs for 'drive' (set to 0.5), 'level' (set to -16), and 'tone' (set to 400). A 'bypass' button is located below these controls. On the right side of the interface, there are audio and MIDI input settings, including a volume slider and a 'DSP' section with 'AudioWorklet' selected. The bottom right corner shows a play button and the text 'Output is On'.

2018: Ableton comes in the game!

Applications 10 of the best way... Get started | Lear... Zenodo (88) SMC-22 Live... Audit Qualiopi - 2... Demo audio - Goo... Rapport CSI - Goo... Thèse Maroua Tik... Méthodes informa... MuVIN » | Autres favoris

Learning Synths — Get started

Get started making sounds

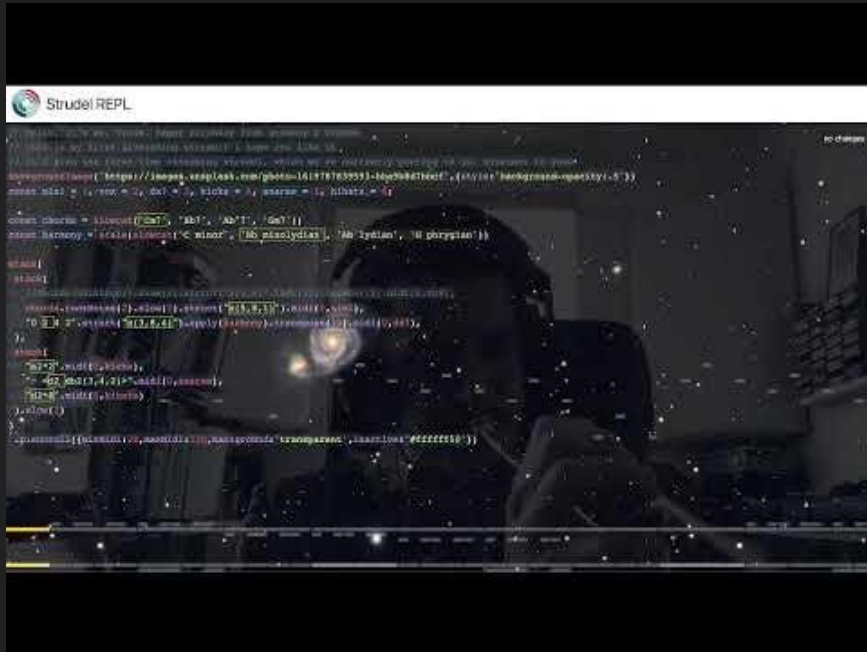
Drag in the box below to play a *synthesizer*.

If you don't hear anything, make sure your sound is on and the volume is turned up. And please use headphones for the best experience!

DRAG

Chapters

2018: the live coding community shines



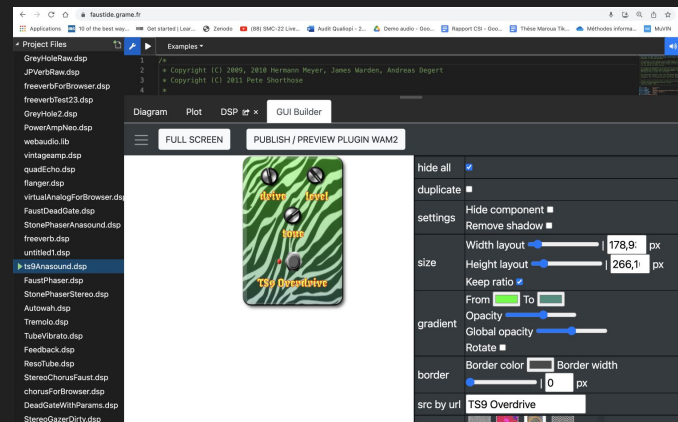
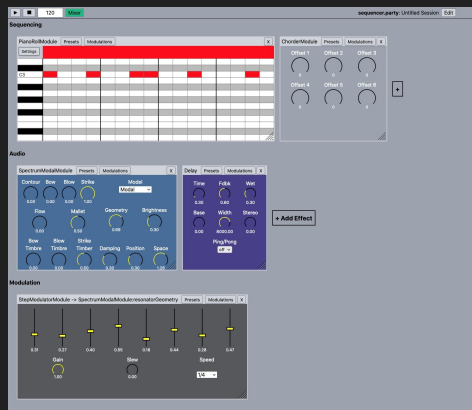
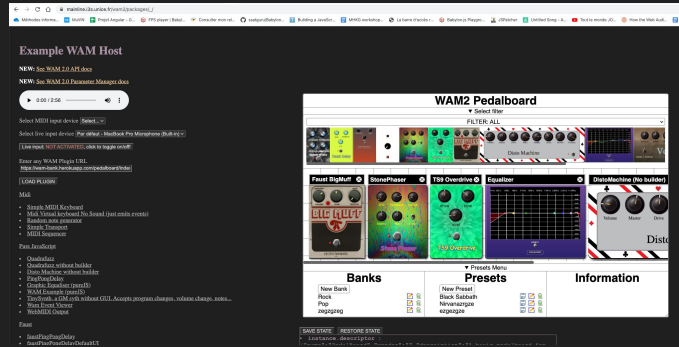
Strudel in 2022



Strudel (Roos, Mclean), Gibber, (Roberts and Joann), Estuary (Ogborn and Beverley), Hydra, Wags, Feedforward, etc.

Some projects started in 2012...

2022: Web Audio plugins become mature (WAM)



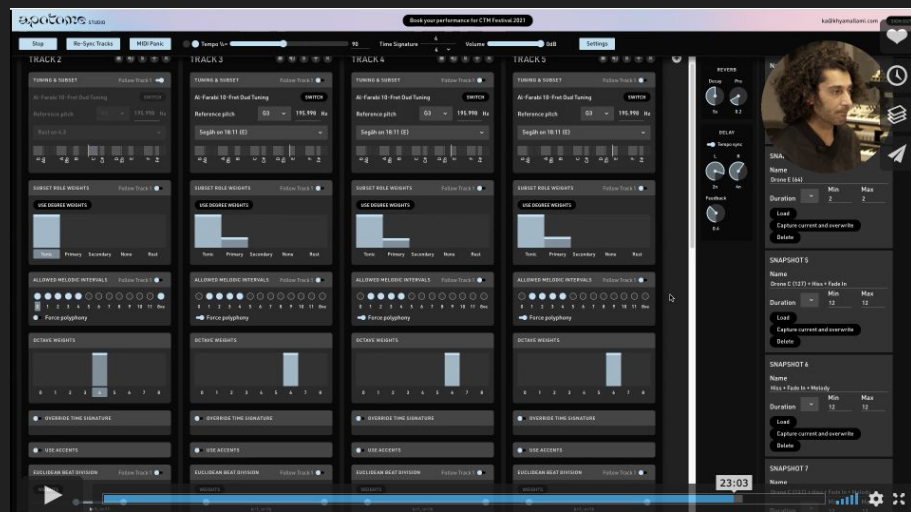
2022: Roland comes in the game!

The screenshot displays the Roland50 Studio software interface within a web browser. The browser's address bar shows 'roland50.studio'. The interface features a top navigation bar with the 'Roland50 Studio' logo and several module selection buttons: SH-101, TB-303, SP-404, TR-606, TR-808, and a BPM control. The main workspace is divided into two panels. The left panel, titled 'Rhythm Composer' and 'Computer Controlled TR-808', shows a 16x12 grid of colored dots (red, orange, yellow, white) representing a drum pattern. Below the grid is a control panel with a 'RANDOM' button, a 'START' button, a 'TEMPO' knob, a 'CLEAR' button, a 'SHUFFLE' knob, and a 'FILL' button. The right panel, titled 'TB-303' and 'Computer Controlled Bass Line', shows a 16x12 grid of white triangles on a grey background, representing a bass line. Below this grid is a control panel with a 'RANDOM' button, a 'RUN STOP' button, and five knobs labeled 'CUT OFF FREQ', 'RESONANCE', 'ENV MOD', 'DECAY', and 'ACCENT'. A 'CLEAR' button and a 'WAVEFORM' selector are also present.

2022: Microtonal synthesizer (Khyam Allami / counterpoint)

LEIMMA: explore microtonal tuning systems

APOTOME: generative music composition tool, which lets you use all the tunings from LEIMMA

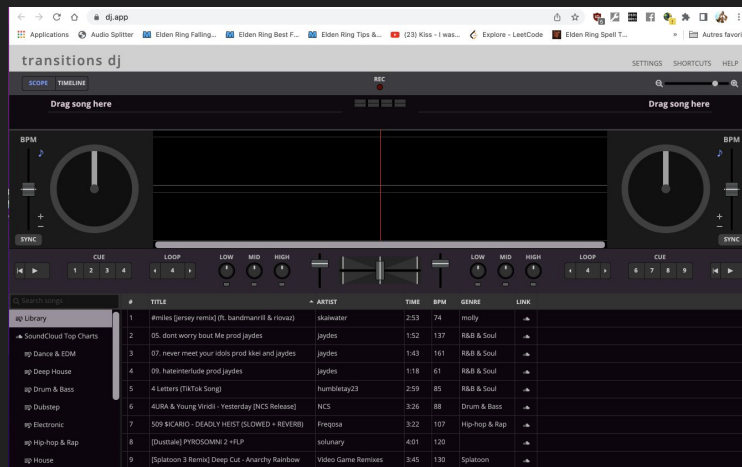
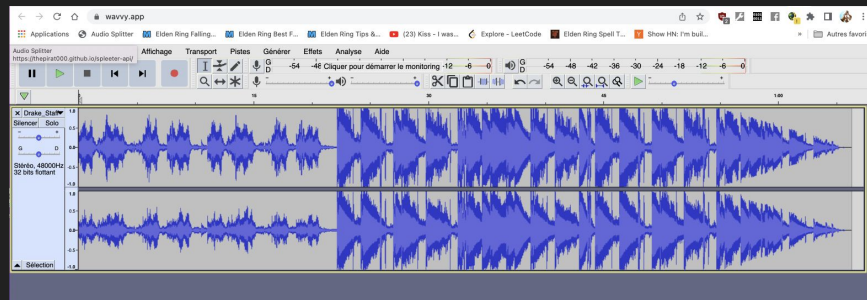


2022: Audacity (the real one) on the Web thanks to WASM

Port of audacity on the Web!

- WASM compiled

Also: WASM port of transitionDJ app



CONCLUSION

The Web platform is Magic :-)

Web Audio is a technology but it also became a new, multidisciplinary, research field



Web Audio lives along with all other APIs, and goes beyond the browser now...

WebML, WebCodecs, WebAudio API standalone in embedded systems, etc.