

Vizualizacija zvučnog zapisa uz pomoć WebGL-a

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- Glazbene vizualizacije
- Korištena tehnologija
- THREE.js
- Web Audio API
- Primjer I
- Primjer II
- Primjer III

Glazbene vizualizacije

- Glazbene vizualizacije su elektronički generirani oblici i slike bazirane na zvučnom zapisu, a omogućavaju slušatelju da „vidi” glazbu koju sluša.
- Slikovni zapis se u većini slučajeva generira i renderira u realnom vremenu uz sinkronizaciju sa zvučnim zapisom
- Sastavni dio većine komercijalnih aplikacija za slušanje glazbe

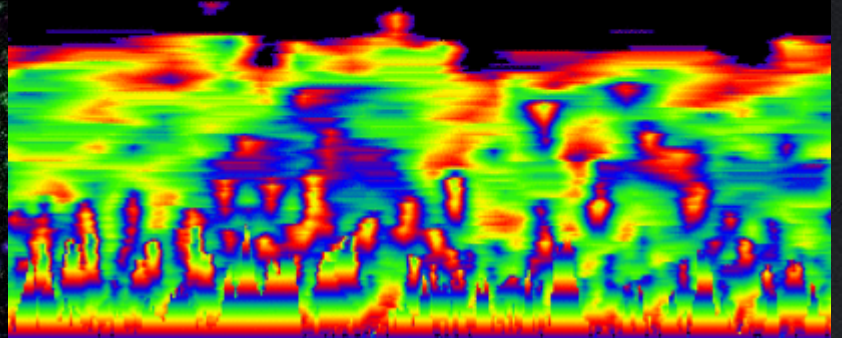
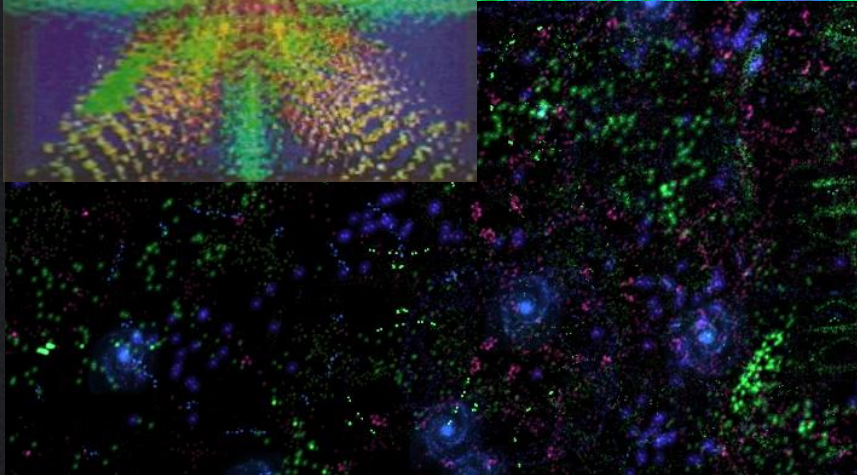
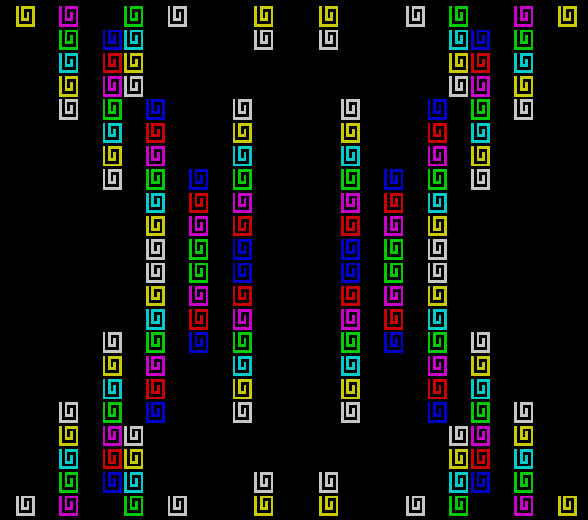
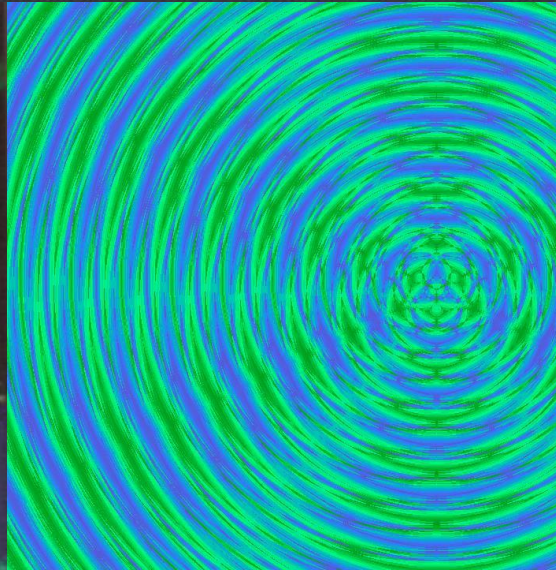
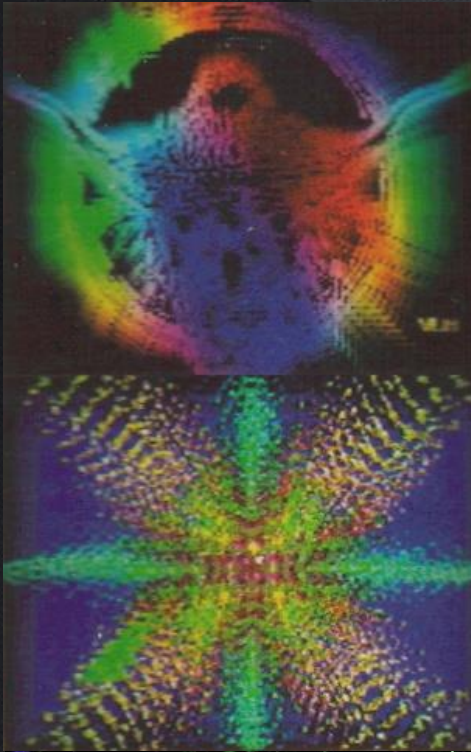
Glazbene vizualizacije

- Generiranje uz pomoć računalne tehnologije
- Ulaz su promjene u glasnoći i frekvenciji, a izlaz su različite vizualne kompozicije koje reagiraju na ulazne paramtere
- Za svaki zvučni zapis vizualizacija je jedinstvena

Povijest

- **Virtual Light Machine** (1990, Jeff Minter) (Platform: Atari Jaguar)
- **Acid Warp** (software) (1992, Unknown) (Platform: DOS)
- **Sonovista Bit Bopper** (1993, O'Wonder)
- **Cthugha** (1993, Kevin "Zaph" Burfitt) (Platform: DOS)
- **Inertia Player** (1995, Stefan Danes, Ramon van Gorkom, et al. / Inertia Productions) (Platform: DOS)
- **Windows Media Player** (Microsoft) (Platforms: Windows)
- **AIMP** (AIMP DevTeam) (Platform: Windows)
- **foobar2000** (Platform: Windows)
- **MediaPortal** (OpenSource, Team MediaPortal) (Platform: Windows)
- **iTunes** (2001, Apple) (Platforms: Mac OS X, Windows)
- **Winamp** (Nullsoft/AOL) (Platforms: Windows)

Povijest



Korištena tehnologija

- **WebGL** – „...cross-platform, royalty-free API used to create 3D graphics in a Web browser, based on OpenGL ES 2.0, runs in the HTML5 Canvas element...”
 - https://www.khronos.org/webgl/wiki/Getting_Started
- **THREE.js** – „...a lightweight cross-browser JavaScript library/API used to create and display animated 3D computer graphics on a Web browser.”
 - <http://threejs.org/>
- **Web Audio API** – „...specification describes a high-level JavaScript API for processing and synthesizing audio in web applications. The primary paradigm is of an audio routing graph”
 - <http://webaudioapi.com/>
 - <https://dvcs.w3.org/hg/audio/raw-file/tip/webaudio/specification.html>



- JavaScript
- Izvršava se na GPU
- Temeljen na OpenGL ES (OpenGL for Embedded Systems)
- Koristi HTML5 Canvas element

THREE.js

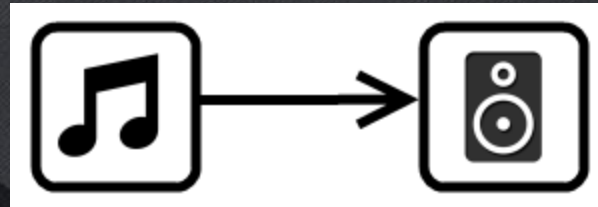
- JavaScript biblioteka/API za 3D računalnu grafiku koja koristi WebGL
- Značajke:
 - ✓ Efekti
 - ✓ Scene
 - ✓ Kamera
 - ✓ Animacije
 - ✓ Osvjetljenje
 - ✓ Materijal
 - ✓ Shaderi
 - ✓ Objekti
 - ✓ Geometrija

.....

Web Audio API

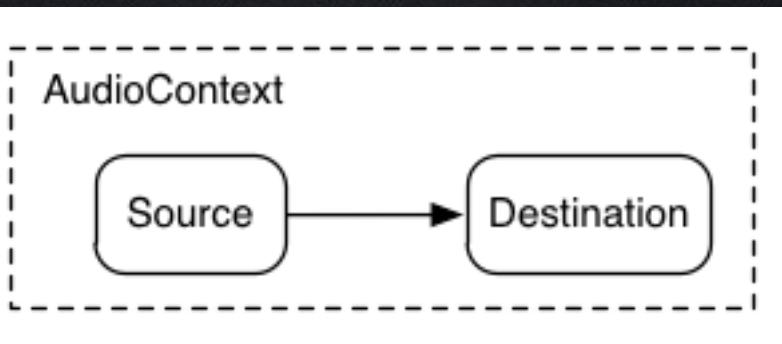
- Modular Routing
- Automation
- Channeling
- Live audio
- Spatialized audio
- Convolution engine
- Dynamics/Compression
- Waveshaping
- Oscillators

Web Audio API



- Modular Routing

- omogućuje proizvoljne konekcije između različitih AudioNode objekata.
- svaki čvor može imati ulaze i izlaze
- ishodišni nema ulaze, odredišni nema izlaze
- sve se automatski odvija na nižoj razini bez potrebne interakcije: „the right thing just happens”



```
var context = new AudioContext();  
  
function playSound() {  
    var source = context.createBufferSource();  
    source.buffer = dogBarkingBuffer;  
    source.connect(context.destination);  
    source.start(0);  
}
```

Web Audio API

- Modular Routing



Web Audio API

- Analyser node

```
interface AnalyserNode : AudioNode {  
  
    // Real-time frequency-domain data  
    void getFloatFrequencyData(Float32Array array);  
    void getByteFrequencyData(Uint8Array array);  
  
    // Real-time waveform data  
    void getByteTimeDomainData(Uint8Array array);  
  
    attribute unsigned long fftSize;  
    readonly attribute unsigned long frequencyBinCount;  
  
    attribute double minDecibels;  
    attribute double maxDecibels;  
  
    attribute double smoothingTimeConstant;  
  
};
```

- fftSize – ne-nulta potencija broja dva u rasponu 32 – 2048
- frequencyBinCount – polovica veličine fftSize
- getFloatFrequencyData – kopira trenutne podatke o frekvencijama u niz
- getByteFrequencyData – kopira podatke o frekvencijama u unsigned byte niz

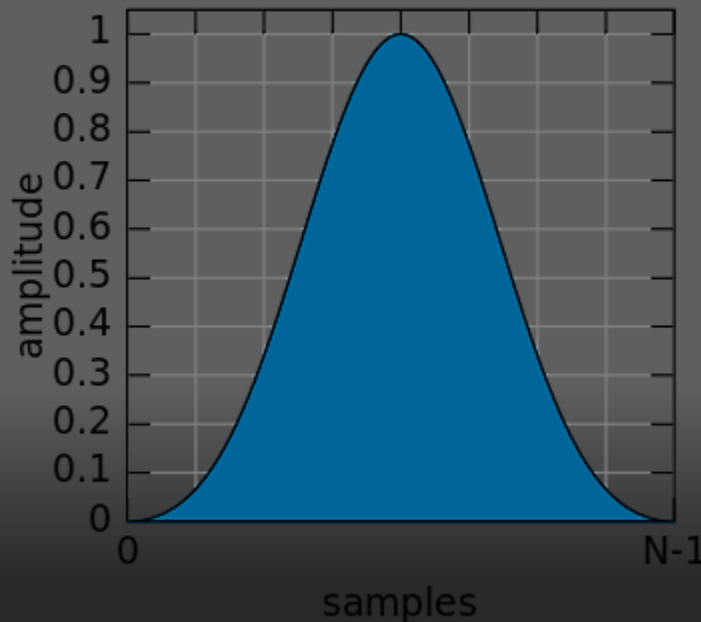
Web Audio API

```
function blackmanWindow(buffer) {  
  var alpha = 0.16;  
  var a0 = 0.5 * (1.0 - alpha);  
  var a1 = 0.5;  
  var a2 = 0.5 * alpha;  
  
  for (var i = 0; i < buffer.length; i++) {  
    var x = i / buffer.length;  
    buffer[i] *= a0 - a1 * Math.cos(2 * Math.PI * x) +  
      a2 * Math.cos(4 * Math.PI * x);  
  }  
}
```

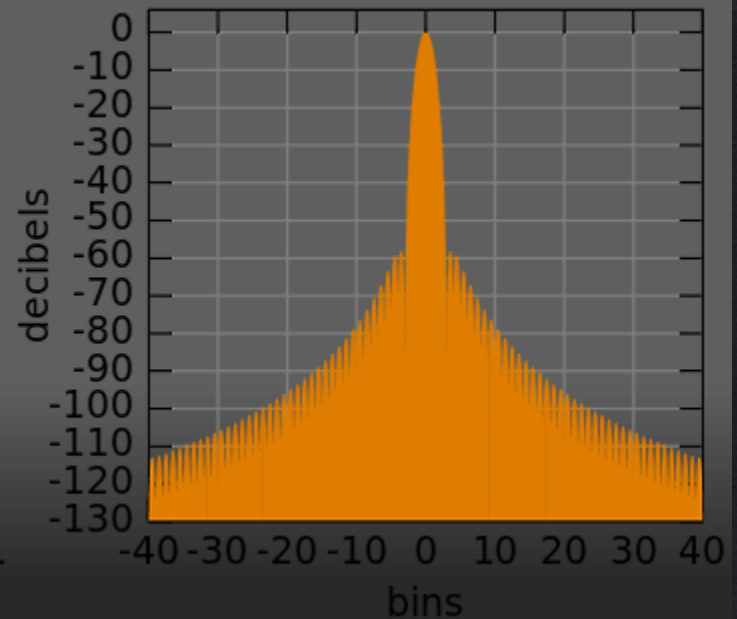
- Frequency-domain analiza

- Spektralna analiza uz pomoć Blackman Window algoritma

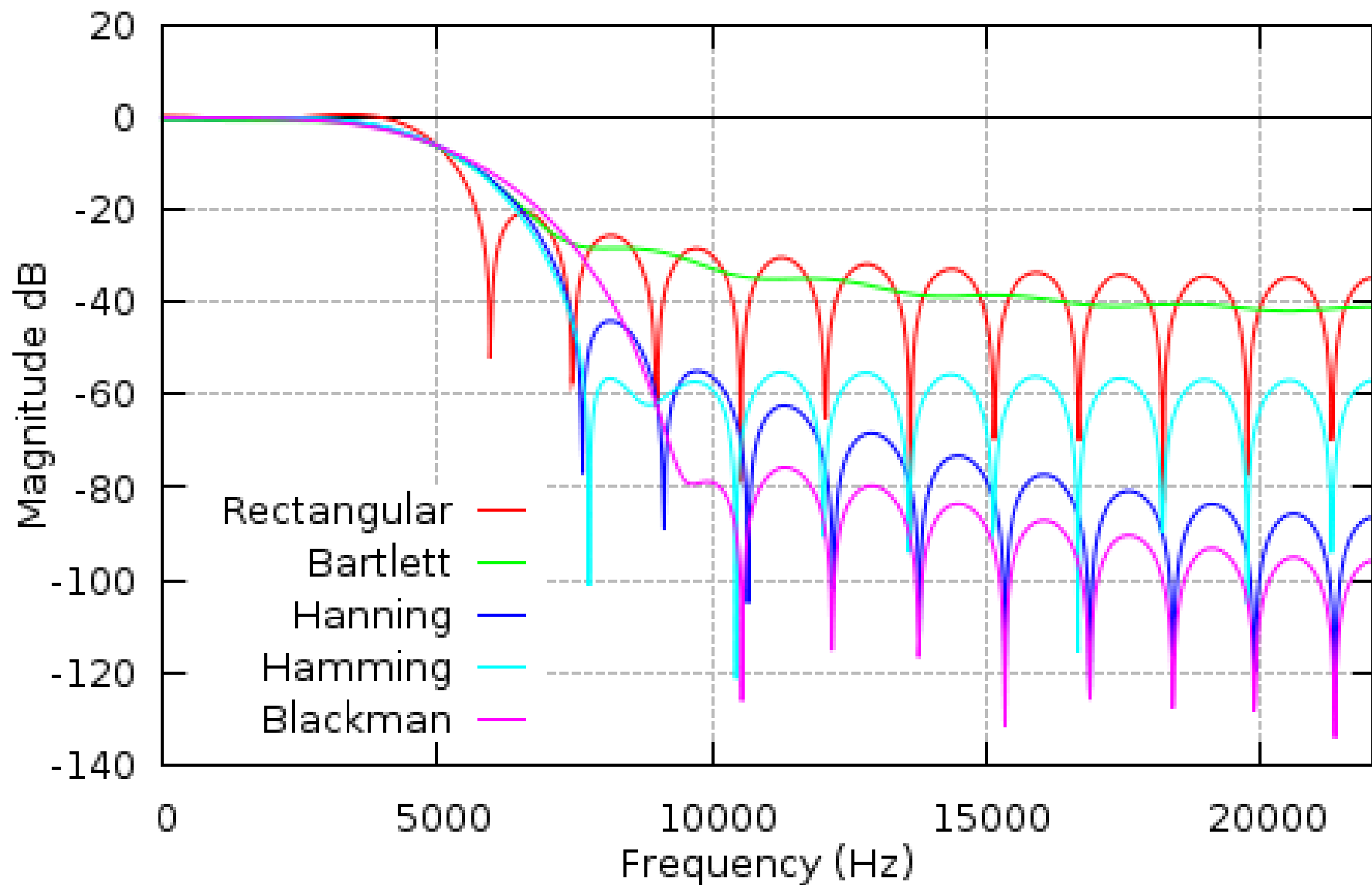
Blackman window



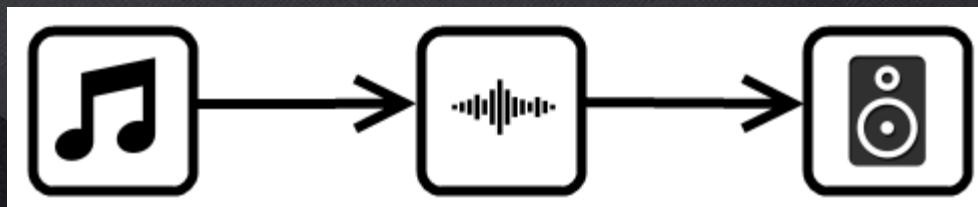
Fourier transform



Web Audio API



Web Audio API



```
$("#player").bind('canplay', function () {  
  //uzimamo player  
  source = audioContext.createMediaElementSource(this);  
  //prespajamo analyser na izvor zvuka  
  source.connect(analyser);  
  //prespajamo iz analysera prema odredištu zvuka/zvučnoj kartici  
  analyser.connect(audioContext.destination);  
  
  console.log(analyser.fftSize); // 2048 defaultna vrijednost  
  console.log(analyser.frequencyBinCount); //1024 data points  
  
  analyser.fftSize = 64;  
  frequencyData = new Uint8Array(analyser.frequencyBinCount);  
  
  console.log(analyser.frequencyBinCount); // fftSize/2 = 32 data points  
  updateAnalyser();  
});
```

▼ Uint8Array[32]

0: 255

1: 246

2: 215

3: 199

4: 165

5: 144

6: 132

7: 131

8: 135

9: 135

10: 130

11: 144

12: 151

13: 149

14: 141

15: 118

16: 140

17: 160

18: 144

19: 112

20: 124

21: 121

22: 115

23: 120

24: 117

25: 102

26: 97

27: 98

28: 86

29: 72

30: 43

31: 0

length: 32

Primjer 1

Primjer 2

Primjer 3

Zaključak

- Potencijalna poboljšana :
 - BeatDetection algoritam
 - Napredni shaderi
 - Integracija sa servisima poput SoundCloud-a

Literatura

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- II. http://en.wikipedia.org/wiki/Music_visualization
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- V. <http://www.html5rocks.com/en/tutorials/webaudio/intro/>
- VI. <http://ianreah.com/2013/02/28/Real-time-analysis-of-streaming-audio-data-with-Web-Audio-API.html>
- VII. <http://webaudio.github.io/web-audio-api/#blackman-window>