# 12 GrooveSpired

Application for **Drums Training** with Beat Recognition

● Signal Separation

Discrete wavelet transform (DTW) is signal transformation used for time-frequency analysis. It is a good alternative to Short Time Fourier Transform (STFT). The result of DWT is a decomposition of the input signal into detailed and approximation coefficients. This is achieved by highpass and lowpass filtering of the signal time domain.

After application of DWT cascade we get detailed and approximation coefficients for each frequency band. Some frequency bands may contain a signal of the drum set instrument.
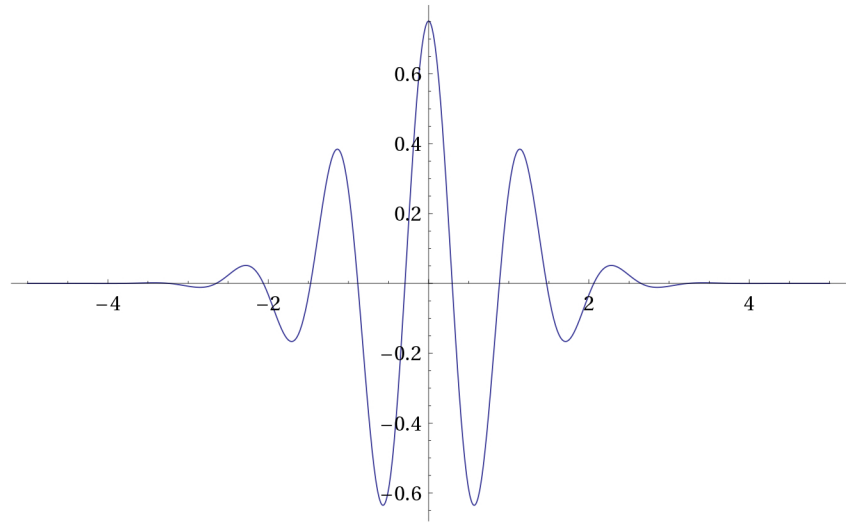
For hi-hat cymbal it is a frequency band with interval 11025 Hz - 22050 Hz, for snare drum 689 Hz - 1378 Hz and bass drum 43 Hz - 86 Hz. To convert the signals back to the time domain, coefficients for all the bands except the chosen one are set to zero and then we apply the In- verse Wavelet Transform.

● Onset Detection

Exact times of drummer hits are computed with an onset detection. For every signal we must consider acoustic properties of instruments, environment, various decays and also signal noise.
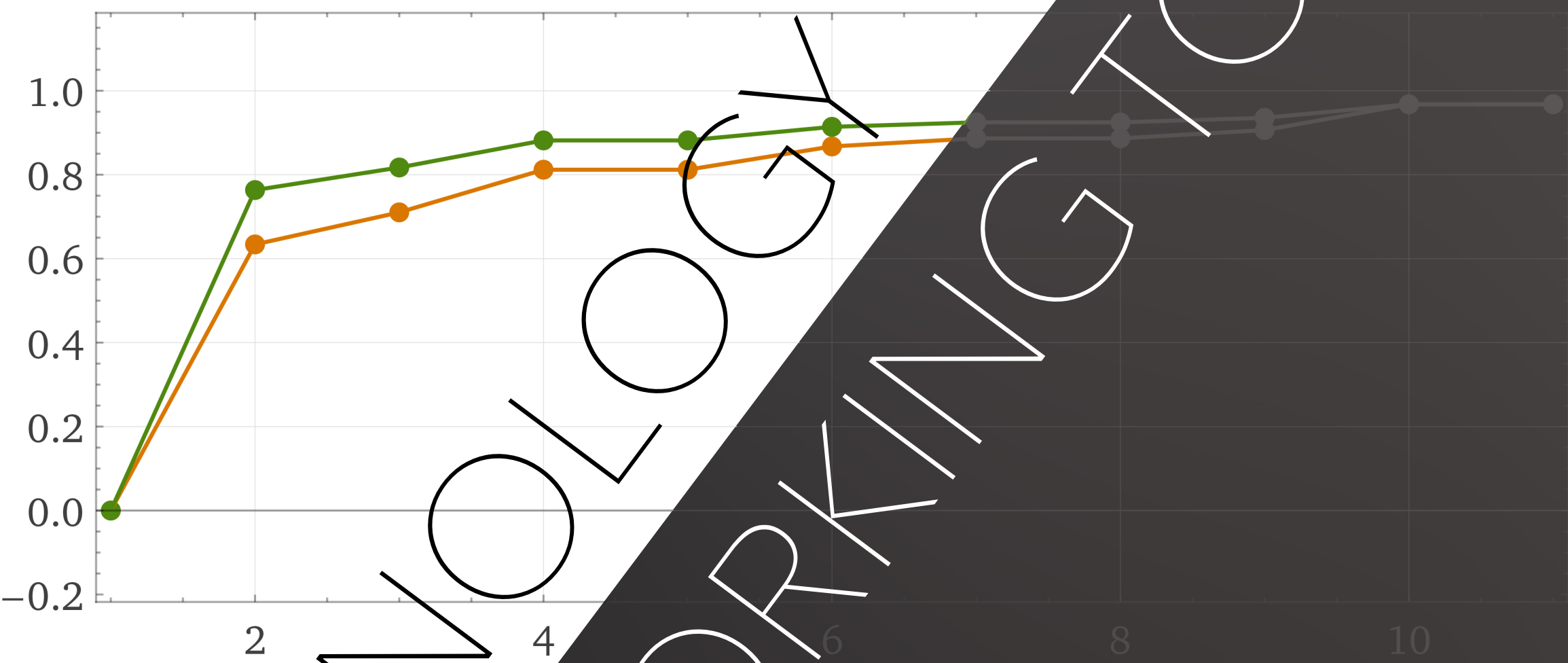
● Experiments

At first, method was imple- mented in Python scripting language. Several MIDI groove files of different music styles (funk, rock and metal) were created for testing. The first module of this testing script synthesized all MIDI grooves into the audio files. It used real drum sounds and added a hall effect to make records as real as possible. Next module of the testing script analyzed record files and the last module compared hit times of MIDI files and detected hit times with variable time tolerance.

Results shown that method is suitable for beat recognition of grooves containing basic parts of the drum set. Experiments also suggested reasonable time tolerance - 0.1 of a second - which was used in iOS mobile application. Metal grooves shown the worst results, because of fast bass drum strokes. The best result is an accuracy value 0.97% for funk music style with tolerance 0.11 of a second.
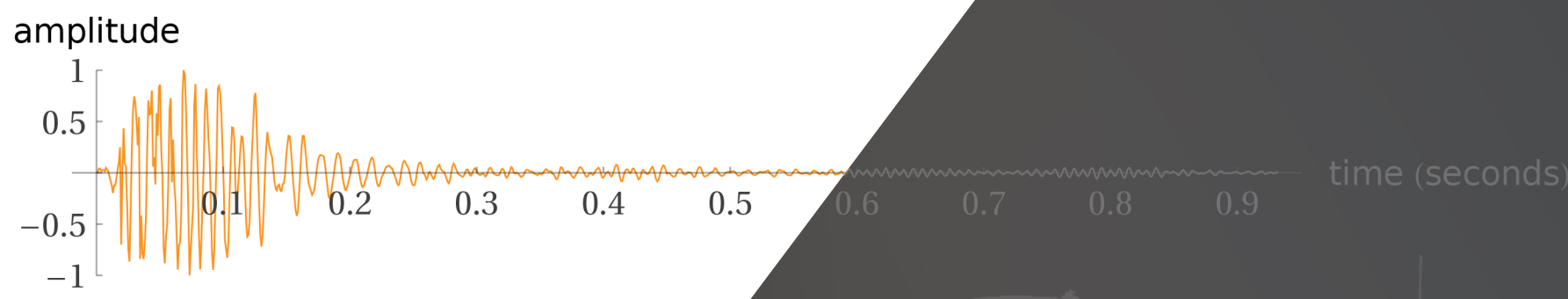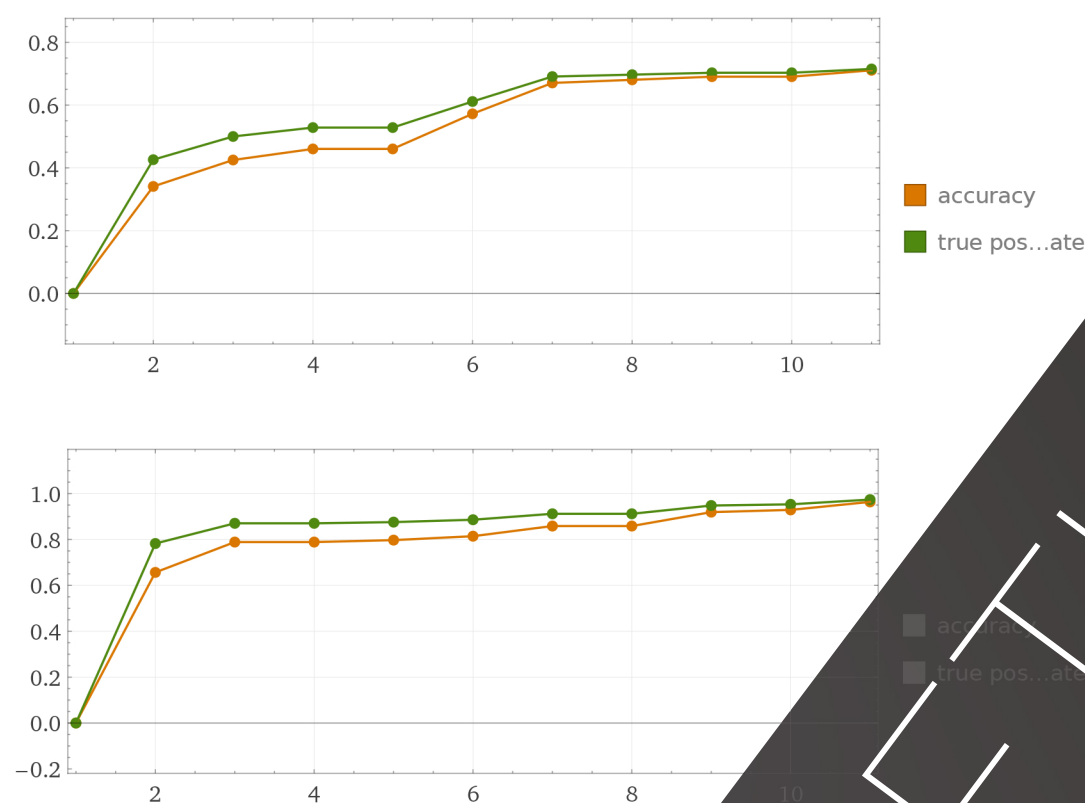
Bass drum and snare drum are mem - branophones constructed from corpus and drum heads. On the other hand, cymbals produce the highest frequency signal from all musical instruments.

TECHNOLOGY AND ART WORKING TOGETHER
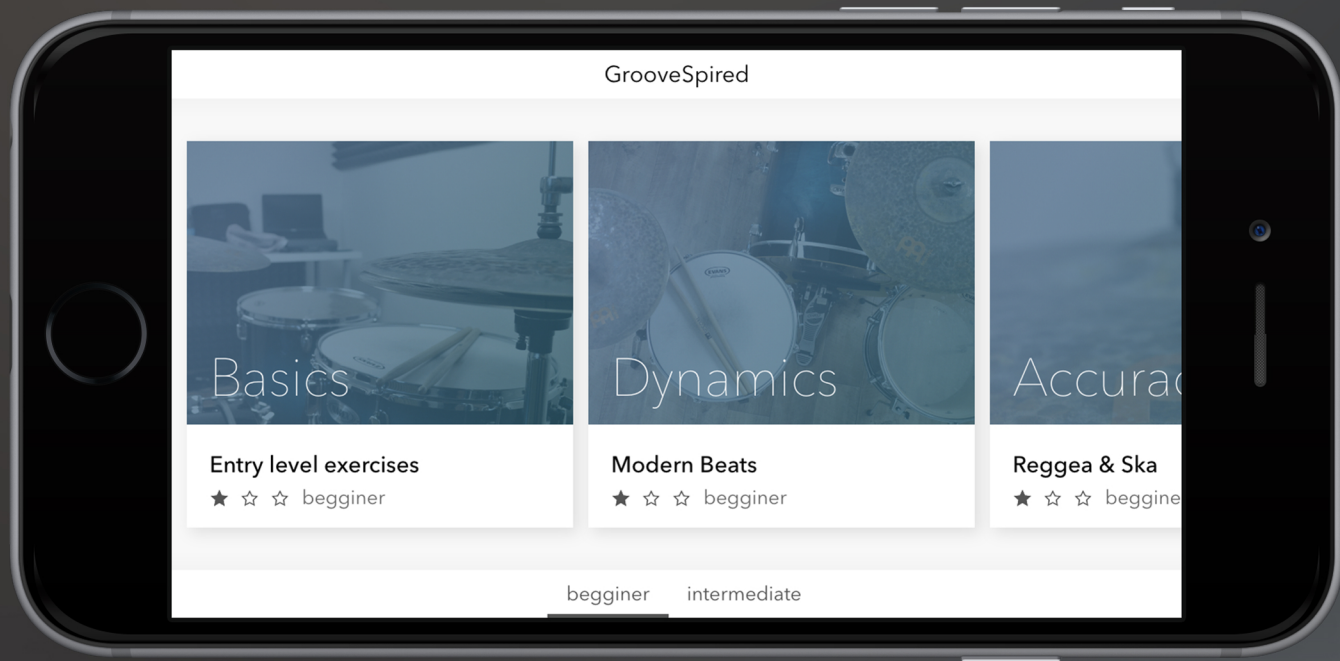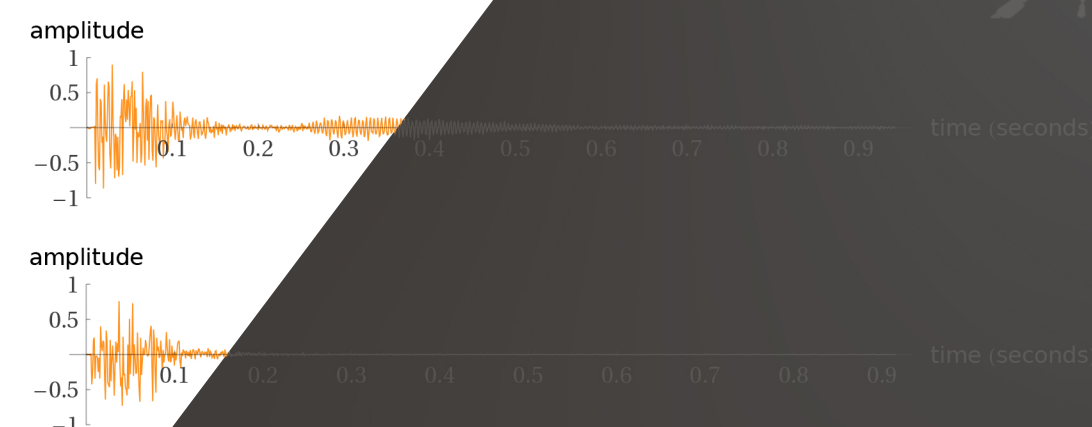
What am I going to practice today? ●
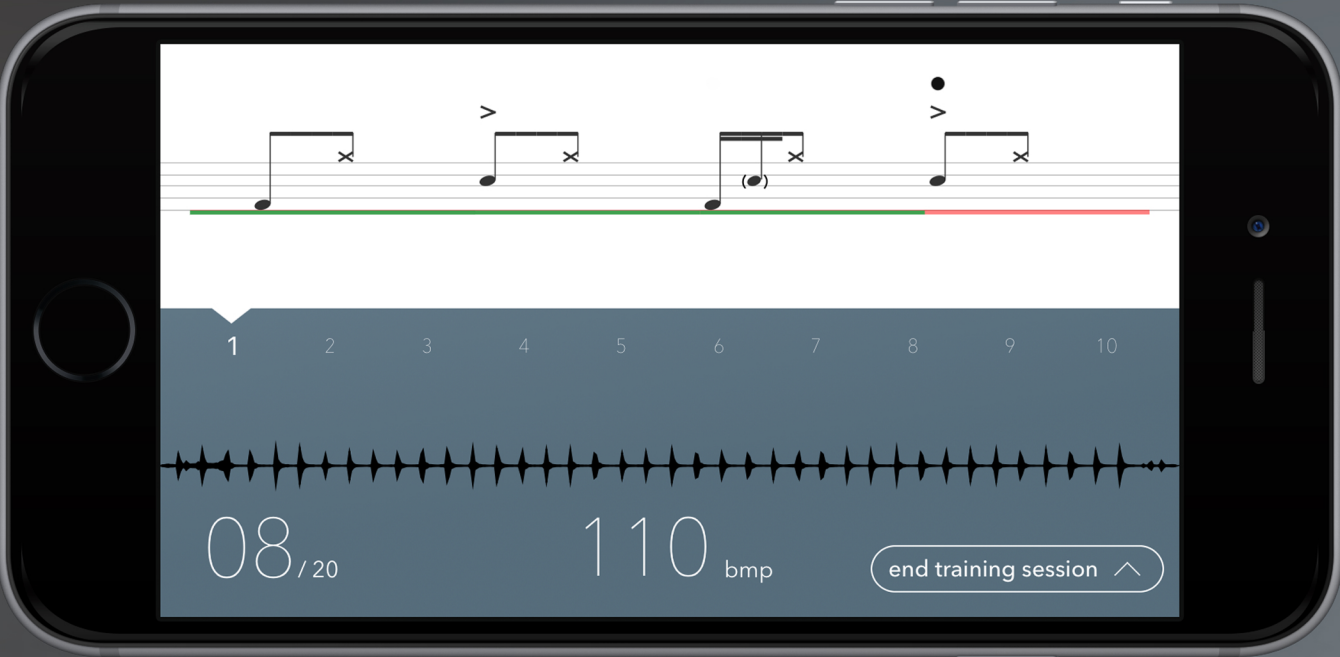
Am I playing it right? ●

Am I ready? ●

How accurate was my drumming? ●

POP   ROCK   SKA   FUNK   JAZZ   METAL