

Real-Time Formant Filter

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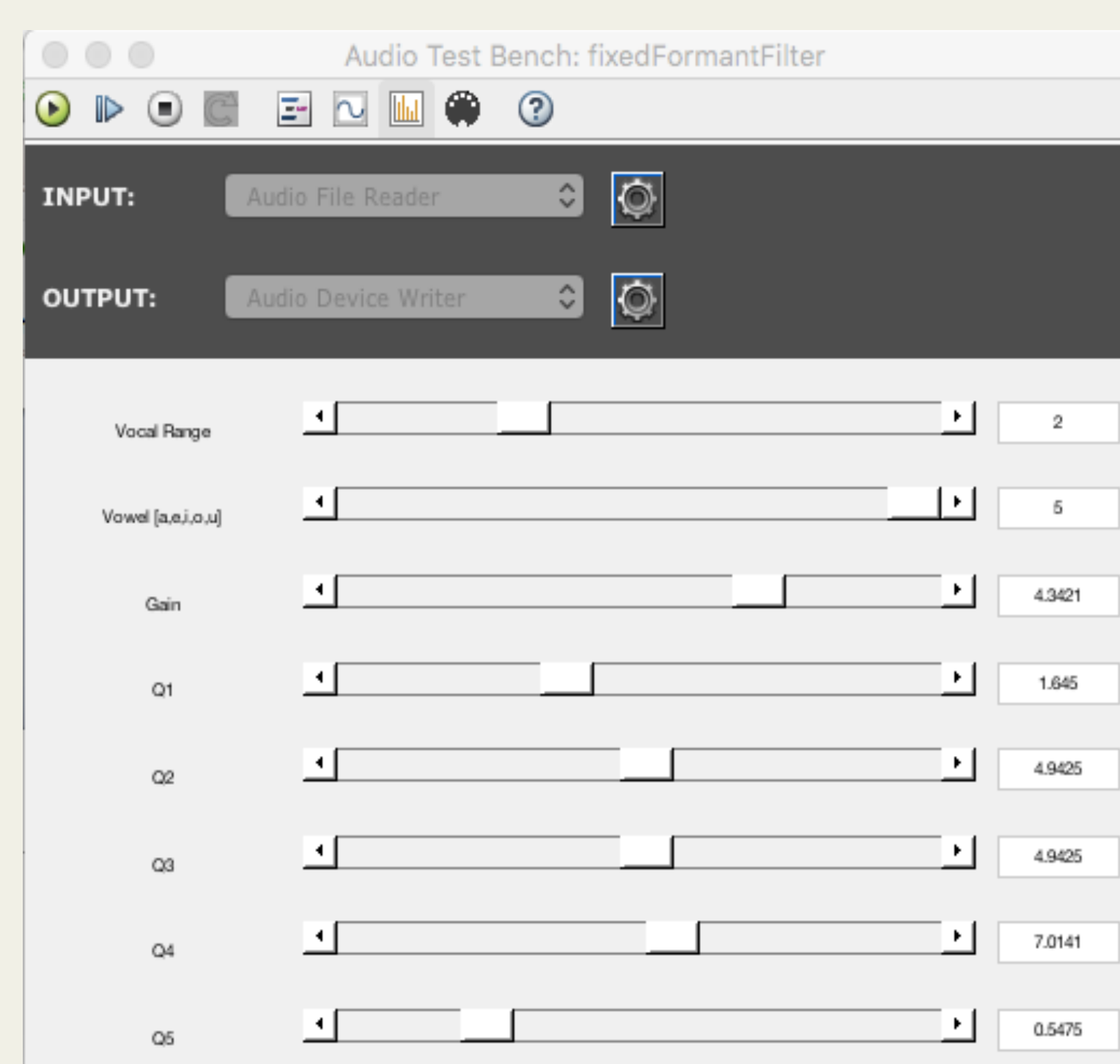
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Abstract: Formants are described as the 4-5 resonant frequencies that encapsulate the vowel sounds from the human voice. The common frequencies of these vowel sounds have been of interest for years in the music information retrieval community for determining the spectral elements of speech. This project includes conclusive frequencies from various ranges of vowel sounds which can be used to help vocalize audio signals.

Methods: This project is based around MATLAB and the Audio Test Bench for developing audio plug-in MATLAB classes [1]. The plug-in also uses a look-up table from the Csound Manual [2]. The formants are categorized by the vocal range and the vowel sound they are associated with. The five vocal ranges are Soprano, Alto, Countertenor, Tenor, and Bass, whereas the vowels are A, E, I, O, and U. A MultibandParametricEQ system object with 5 bands was used to filter the sound, along with sliders to vary each bands quality factor (Q). A single slider for gain was also added for the filter's overall gain variability.

Results: Displayed are spectral plots of pink noise being filtered by the formant filter. The variability in the quality factor increases distortion and clipping effects. Besides that, the filters work as they should. Performance is better with polyphonic recordings. Monophonic recordings only produce vowel sounds when they are in one of the filter's harmonics.



Future Work: Only having 25 different combinations of formants is limiting. To further innovate on the amount of formant sounds that can be produced it would be well to implement dynamic interpolation between the various sounds when moving the slider bars. Currently, the top two sliders that represent the vocal range and the vowel sounds are represented by the integer interval (1, 5). If the integers were turned to doubles and there was interpolation between the frequencies based on the sliding doubles, then this would enable to user to explore more combinations of possible formant sounds.

Another goal is to track the formants from a user's own vocal sample. The formants from the user sample could then be placed as the center frequencies for the bands and allow the user to alter the formants to achieve the ideal sound design of their output.

The best way of doing this would be to take the sample, isolate the section of the sample that represents the formants, track the formant frequencies, and then use those frequencies as the center frequencies of the parametric bands. These steps have already been done, but there needs to be a bridging of the gap between the methods of collecting frequencies and implementing them in an audio plug-in. Because most audio plug-ins only have one input and output, whereas this proposed plug-in would need two inputs, one from the vocal microphone, and the other from the source that is meant to be filtered.

References:

- [1] MATLAB Documentation
- [2] Csound Manual
https://www.classes.cs.uchicago.edu/archive/1999/spring/CS295/Computing_Resources/Csound/CsManual3.48b1.HTML/Appendices/table3.html

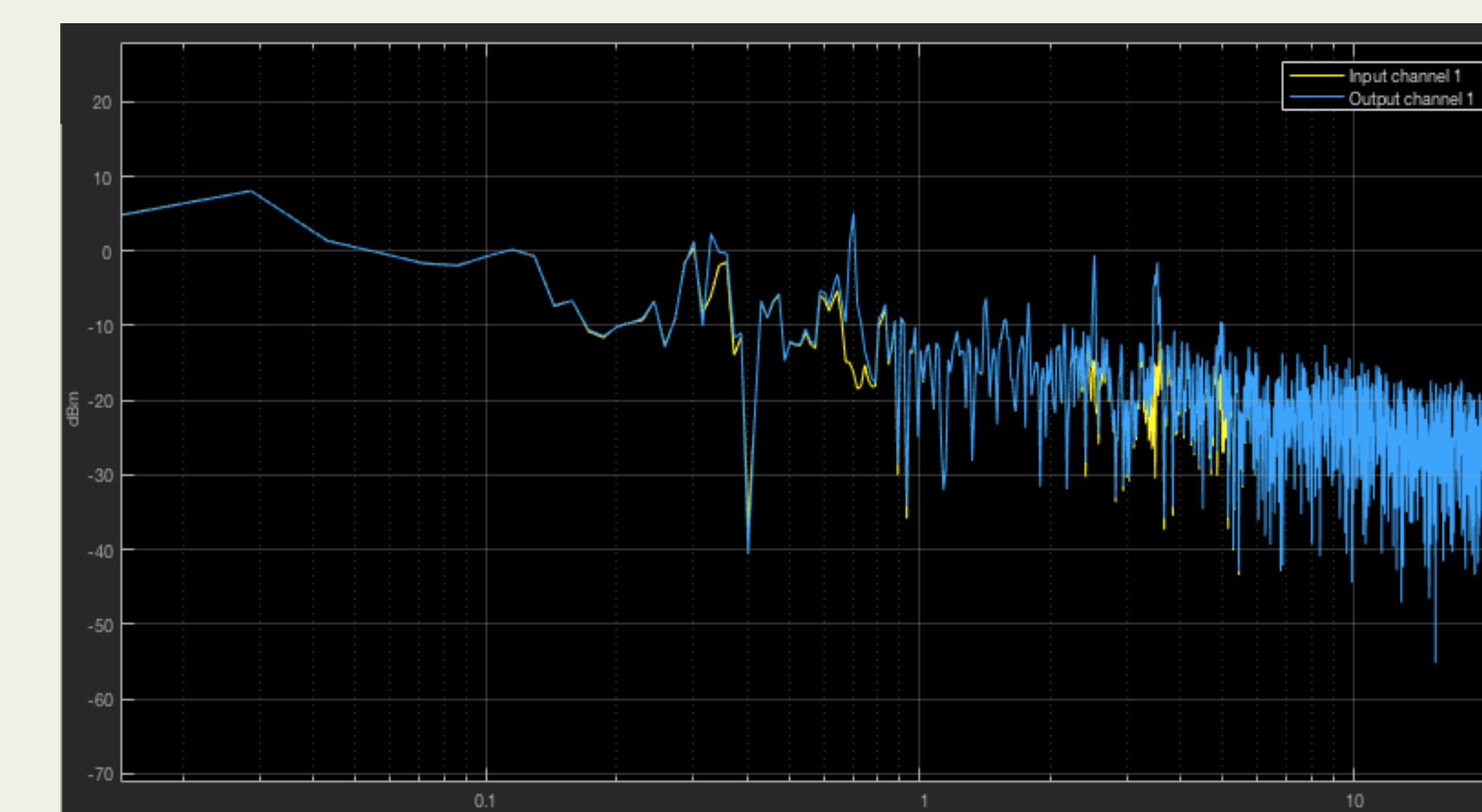


Figure 2: Alto U: [325, 700, 2530, 3500, 4950] Hz, High Q

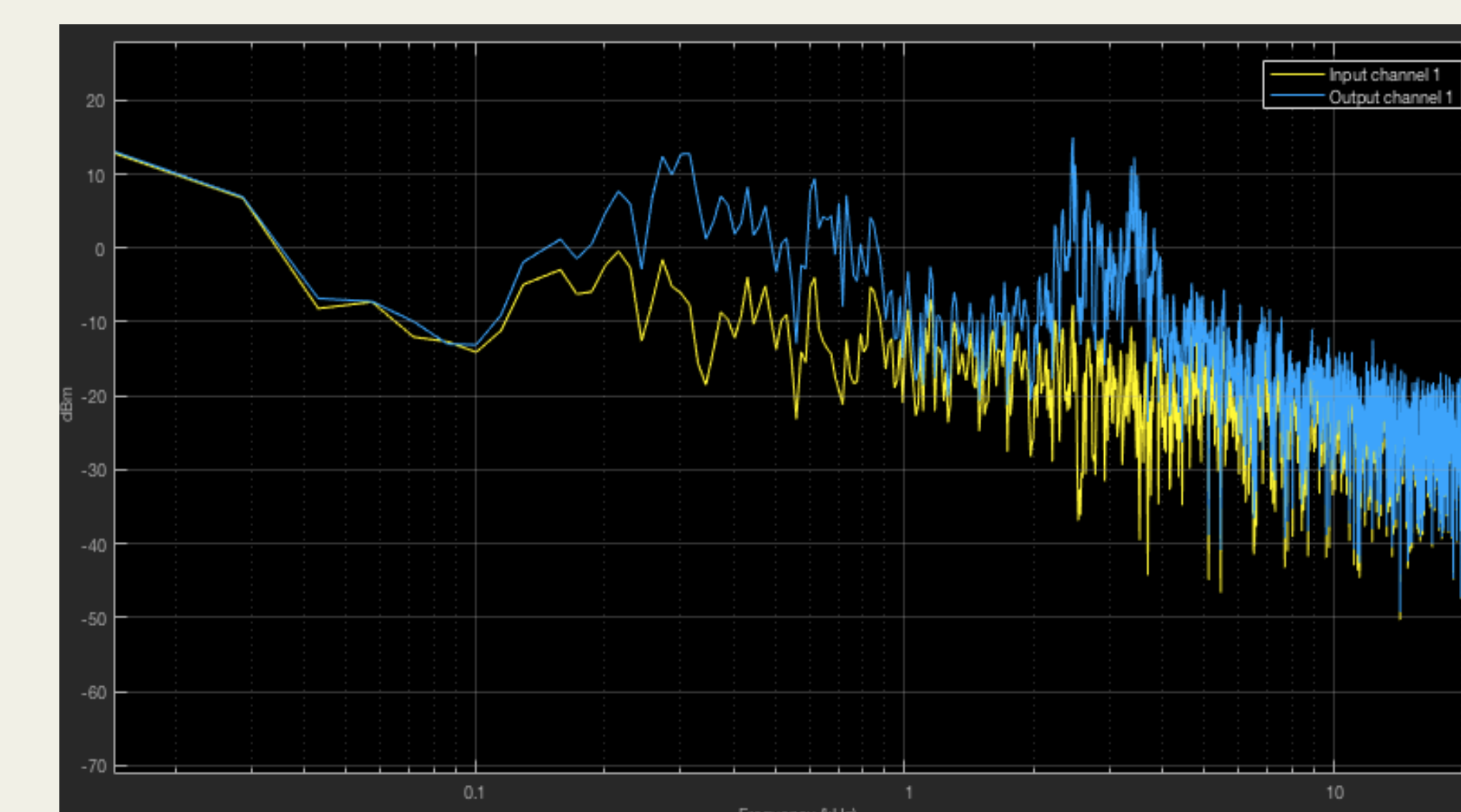


Figure 3: Alto U: Low Q

Figure 1: Graphical User Interface for Formant Filter