Intuitive EQ User Interfaces

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Abstract

This paper takes a look at some examples of research on the topic of EQ user interfaces and discusses their merits and drawbacks. Topics include a novel corrective EQ user interface, a new way to control a parametric equalizer, a method to set up the EQ for hearing aids, subjective equalization, and a way to crowdsource timbre descriptors.

1 Introduction

Equalizers can be used in various applications and by different kinds of users from non-experts to audio professionals. Typically, an equalizer has a gain control for three or more audio bands, either with fixed or adjustable Q values and center frequencies.

A fundamental problem with equalizers is that the user interface isn't intuitive for complex tasks, especially for inexperienced users or those who are not audio professionals. People use subjective terms like *warm*, *bright* or *edgy* to describe the spectral characteristics of sound, but the EQ user interface only understands gain in decibels, frequencies in Hz and a numerical Q values. It would be more intuitive to be able to control the EQ based on descriptions of timbre rather than the properties of individual frequency bands.[6]

Some research on the subject indicates that certain subjective terms used to describe the timbral characteristics of sound correlate strongly with a specific sound, and other terms do not. This is partly illustrated by figure 5 which shows the relationship between certain subjective terms and sounds in one study [7]. Figure 5 shows one interpretation of how some subjective terms and frequency bands correspond with each other.

Moreover, subjectivity not only depends on the perception of an individual but also on the spectral characteristics of the sound in question. In other words, two different sounds might require different equalization in order to achieve an end result that is perceived in a similar way.

Another issue is that no user interface research has been performed for professional mixing consoles. [2] presents a new interface meant for simplifying corrective EQ tasks. Digital mixers and DAW interfaces often mimic the user interface and layout of hardware mixers, and don't necessarily take advantage of the possibilities offered by digital technology.

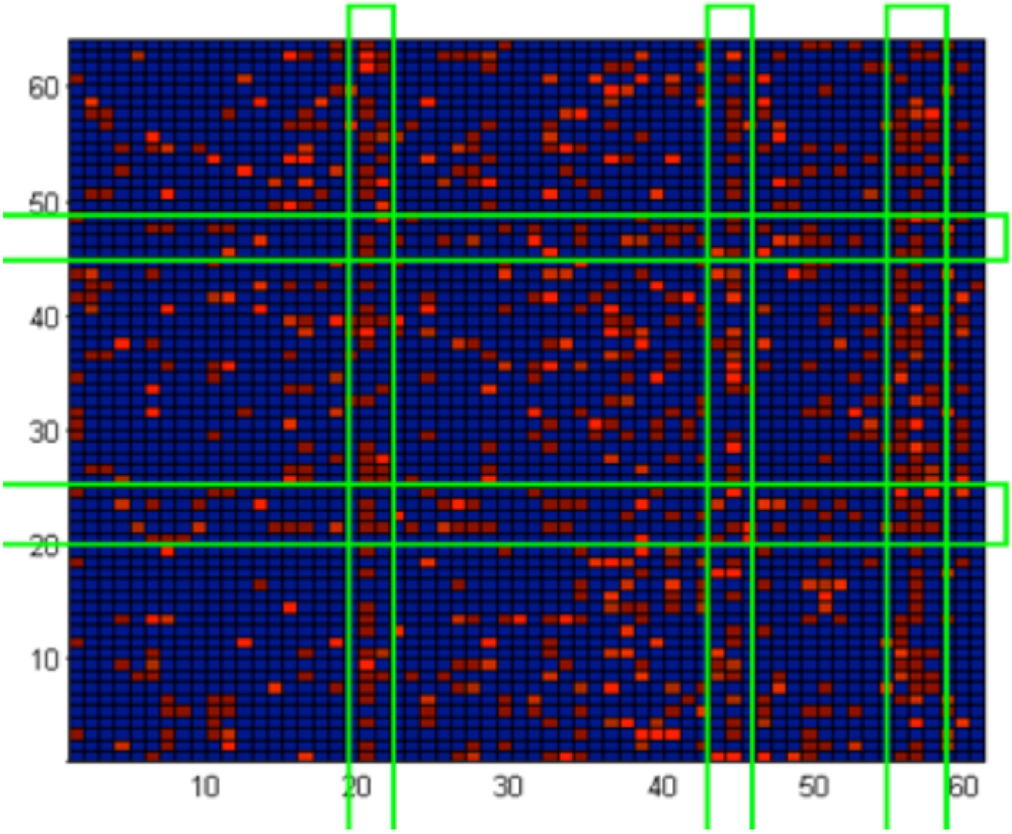

Figure 1: Matrix showing sound/word combinations. Horizontal lines show sounds that can be described with many different words, vertical lines show words that tend to describe multiple sounds. Green Adapted from [7]

2 Corrective EQ using spectral information

[2] presents four novel EQ user interfaces, focusing specifically on professional mixing consoles and parametric peaking EQs. These new methods were tested against traditional EQ user interfaces. Some of the new interfaces stood out as being significantly faster to use than others. The traditional EQ user interfaces tested allowed

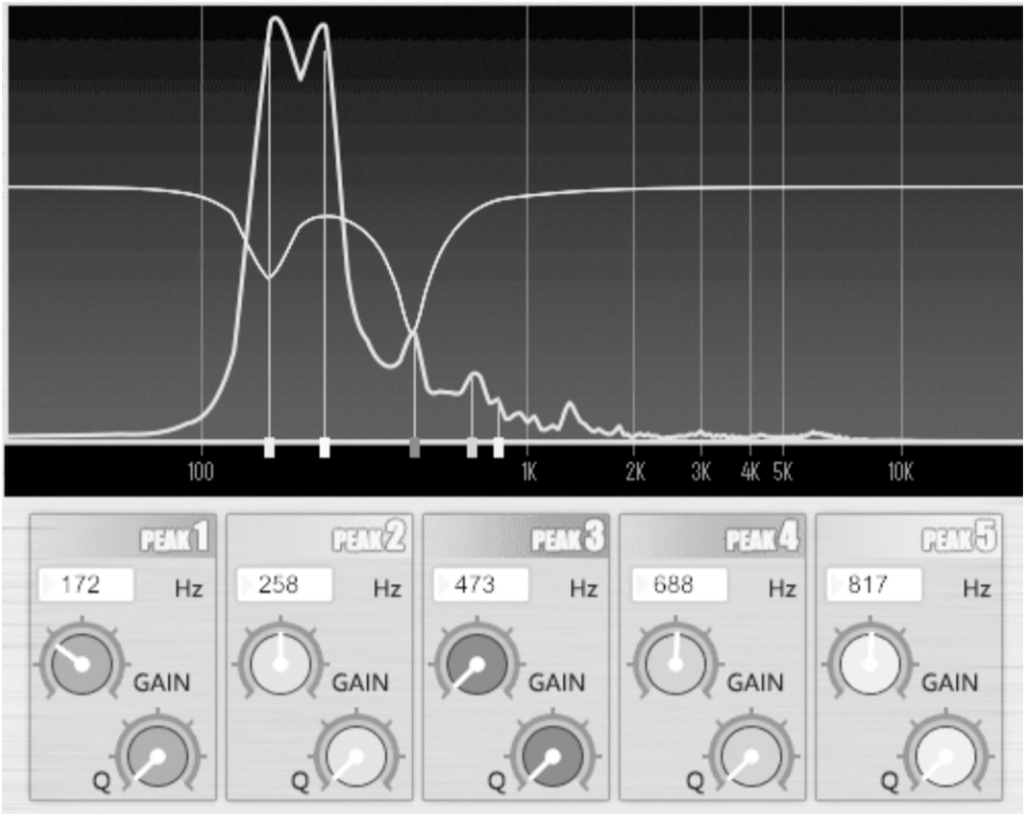

Figure 2: Interface 5 in [2], which displays FFT bin maximums as static spectral information, with five lines indicating the first five FFT bin maximum peaks. Figure adapted from [2]

the user to freely cut or boost any frequency they desire, but they also gave no visual indication of which the important frequencies might be.

The novel interfaces are based on displaying FFT bin maximums and letting the user directly boost or attenuate them. These peaks correspond to resonant frequencies, which are most often the frequencies that someone doing mixing would want to attenuate. In the test, subjects were asked to remove a resonant frequency from a snare drum sound. An example interface (interface number 5 in the study) is shown in figure 2.

The interface that performed the best in the test was interface 5, shown in figure 2. This EQ prototype displays FFT bin maximums as a curve and indicates five FFT maximum peaks in the curve with vertical lines, and the user is only allowed to attenuate these peaks. This interface was found to be the second fastest to use, with an even more minimalist design (interface 7, shown in 3) leading to results even quicker. However, some users seemed to find its streamlined interface too restricting.

It was interesting to read about how problems with finding a suitable metric for ranking the EQ was solved in [2]. Users were already familiar with EQs, so they had preconceived ideas about how an EQ should function, and were sometimes resistant

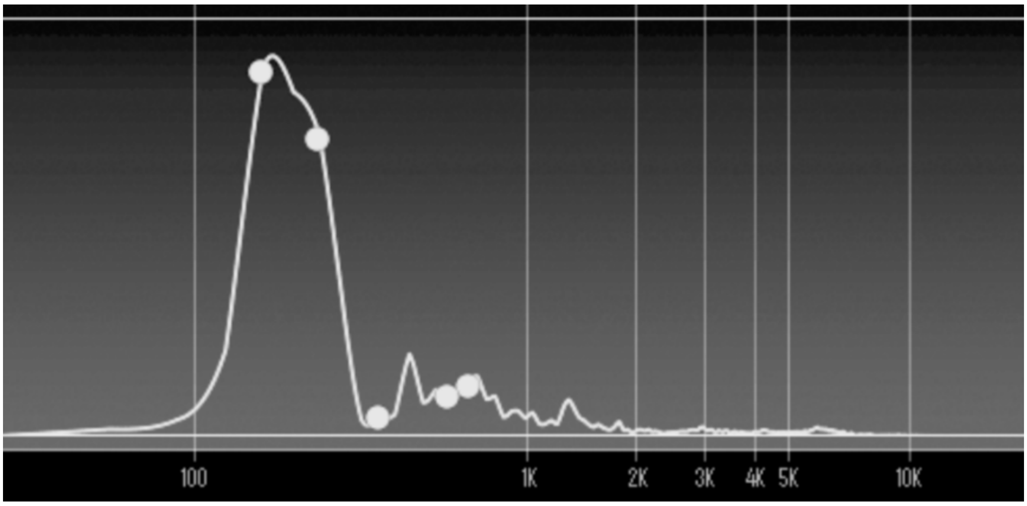

Figure 3: Interface 7 in [2], which displays FFT bin maximums as dots. Spectral curve is updated in real time. Figure adapted from [2]

to some of the new UI ideas. It was also difficult to find a suitable metric for ranking, since different people had different habits of working.

3 Graphical control of a parametric equalizer

The advantages of a parametric equalizer over a traditional graphic equalizer is that a parametric equalizer consumes less computational power and has naturally soft magnitude and phase responses. In order to bring the ease of use of graphic equalizers to parametric equalizers, [4] presents a graphical control scheme for a parametric equalizer.

This user interface is based on the idea that the user can draw an EQ magnitude response curve freehand. However, an exact copy of this desired magnitude response isn't necessarily possible due to the nature of the parametric equalizer. Therefore, the system tries to match the output as closely as possible to this curve. The user can choose from a number of different modes to approximate the magnitude response, such as determining the magnitude response with the aid of anchor points, using two freehand curves to determine upper and lower bounds for the magnitude response, and drawing a set of magnitude responses freehand and determining their order of importance. Figure 4 shows an example of the curves used in the user interface.

The optimization strategy used is called genetic optimization. Highly complex curves might require several seconds of processing time to find the appropriate solution, but less complex curves run at interactive speed. The user can also disregard the optimization and change the settings using sliders instead.

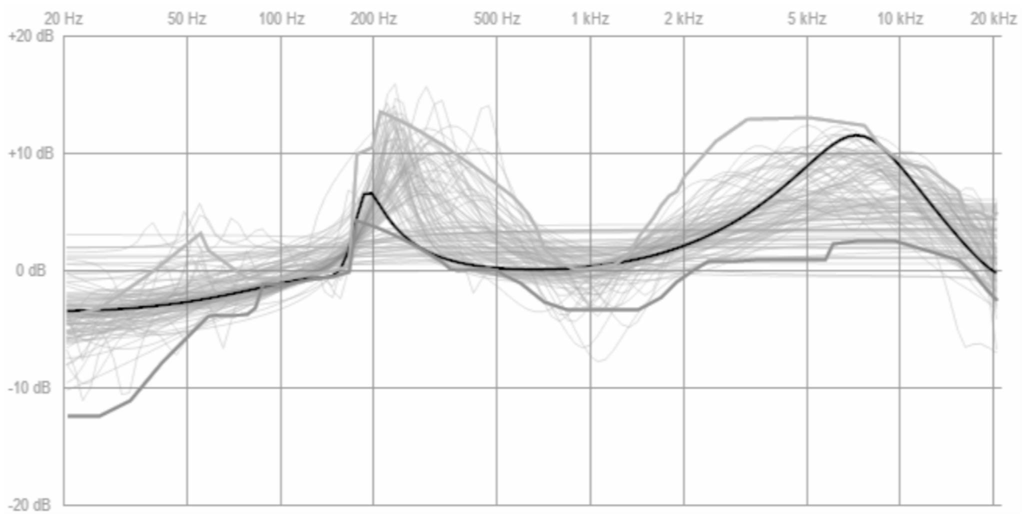

Figure 4: Graphical parametric user interface. Gray curves determine the upper and lower bounds for the magnitude response, which is shown in black. Light gray curves in the background show the current population of the genetic algorithm. Figure adapted from [4]

4 SubjEQt: Subjective equalization

Equalizer frequencies can be connected to perceptually relevant descriptive terms such as warm, airy, edgy, etc. because they roughly correspond to different frequency bands, as shown in figure 5. This was explored in [5], where a set of filters corresponding to different descriptions was arranged in a 2D field. They called the system subjEQt. As shown in figure 6, the user can select any point in the field, also between different terms, and the system creates a filter that is an interpolation between other nearby settings.

5 EQ curve settings for hearing aids

[3] presents an audio effect setup procedure for untrained users. Users are given a series of choices over two differently processed sound examples. The system learns from the choices that the user makes and uses this information to optimize the parameters. The people who took part in the study were all hearing-impaired, and they were asked to adjust an equalizer and a multiband compressor to improve the intelligibility of a TV set.

The user interface used flower-shaped buttons which were computed based on the effect parameters. Similar effect settings result in similar images. The interface is shown in figure 7. Most users changed between two settings 25 to 30 times per minute and made six to eight decisions per minute. In most cases, it took only seven to ten minutes until user reported noticing no difference between the settings.

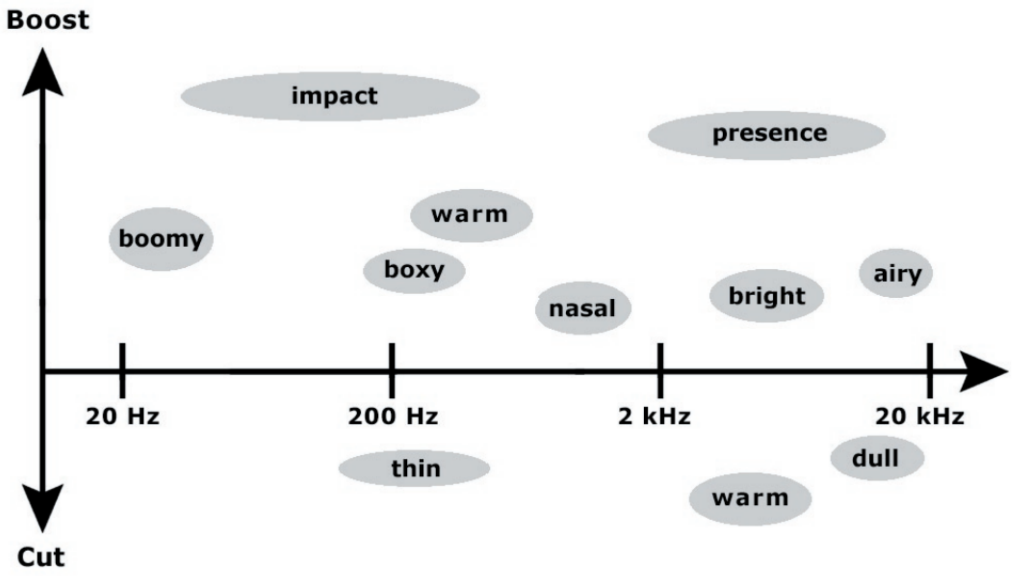

Figure 5: How subjective terms correspond to different frequency bands, according to [5]. Adapted from [5]

Depending on the user, some were able to create a nearly perfect copy of the frequency response curves in their audiograms, whereas most users didn't reach settings that would have compensated for their hearing loss. However, in general users liked the system and found it usable.

6 SocialEQ: Crowdsourcing an Equalization Descriptor Map

[1] presents a tool for learning the vocabulary that people use to describe timbre. Since different people use different words to describe timbre, it is argued in [1] that the best approach is to have a person define how the words they use reflect the sounds they hear.

SocialEQ.org consists of an online interface which allows a user to define a descriptive term that makes sense to them as they please, ether by using one of the provided example sounds or uploading a sound file of their own. The sound is then filtered in different ways, and the user can rate how closely each filtered sound corresponds to the definition. After rating eight different sounds, the system makes its decision of the final equalization curve and presents the user with a filter magnitude response. An example of this is shown in figure 8. A brief overview of the underlying system is presented in section 7.

The web service as it is now is slightly different from the test setup described in the paper, where descriptors were tested multiple times. The system allows the user to use any descriptor that they want, some stranger examples of timbre descriptors were *throbbing*, *dog* and *muscle*.

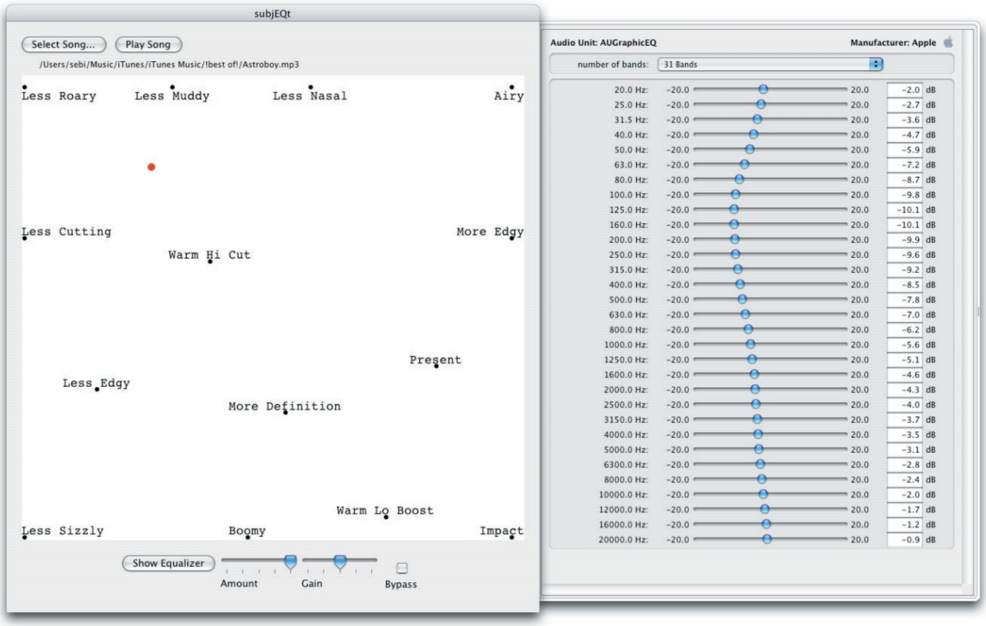

Figure 6: Graphical user interface of subjEQt. Adapted from [5]

7 Mapping language-based descriptors to audio processing parameters

[6] describes a user-personalized approach for learning a listener's desired equalization curve. The user applies a filter (e.g. warm) to an audio file of their choice, and the file is filtered N times with different filter settings. The user then rates how well each filtered audio file corresponds to their perception of the descriptor.

This way the system learns the user's preferences in different cases. This also works around the problem where the same parameter settings might lead to a different perception depending on the sound source.

8 Conclusions

During the past 40 years, music production has slowly changed from being a job only for professionals with special training and access to expensive studios, to a hobby or a job that's much more accessible: nowadays, a home studio can exist inside a laptop. This is one of the biggest incentives for making EQ interfaces more intuitive to use. That said, traditional interfaces will surely co-exist alongside new ones, since they offer the most flexibility. A detail that most papers failed to mention is that quick and intuitive EQ manipulation might be especially useful in live performance situations.

More research is definitely needed in all areas of EQ user interface design, because few of the novel interfaces seemed to satisfy all users, and there was often too large a trade-off between flexibility and ease of use. In some cases it was questionable if the end result provided any benefit, or was perhaps even worse than traditional methods.

References

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Figure 7: User interface of equalizer and multiband compressor. Adapted from [3]

Figure 8: End result of a short session with SocialEQ.org, trying to define what a *warm* sound is like. The user interface allows the user to save the processed file, to play back the filtered sound and to morph the filter between the original and its inverse.