EMERGING TECH CONFERENCE – Edge Intelligence
Volume 01, 2022, Page 103 – 106
Proceedings of Emerging Tech Conference:
Edge Intelligence 2022

Tuning Renesas Audio Products with Audio Tuning Tool (ATT)

Gavriil Kamaris*, Geert Pronk, Fotios Kontomichos
Dialog a Renesas Company, NEO Patras-Athens 15, Patras 26441, Greece
gavriil.kamaris.uj@renesas.com

Abstract

In this technical report, it is presented a software platform used for tuning the parameters of a series of DSP chips introduced by Dialog Semiconductor a company of Renesas. A set of plug-ins is developed to allow the final user to shorten the time-to-market and producing high quality results, by using high level, self-intuitive user interfaces to tune the variable module parameters. The plug ins cover a grate variance of applications supported by Renesas audio codec series including Audio equalization, Echo cancelation, Beamformer and Active Noise Cancelation

1. Introduction & Motivation

Most of the customers' end-products, such as game consoles, headsets, and other communication devices that are based on Wireless Audio Voice sector chips (i.e. in DA740x, DA721x, DA14xxx families) require tuning and/or customization dependent on the end product specifications. In many cases our customers have limited knowledge of the DSP functions and their parameters. A high level software tool is required to assist the engineers to perform such complicated tasks without spending time for familiarizing with several details of the hardware and shorten time-to-market development tasks. Furthermore, Renesas audio products feature multiple operations and can be tailored to multiple conditions and product types, each one requiring a high level of experience in order to operate in realistic scenarios without issues.

The answer to this challenge was to develop a software that supports all the products in the field of audio and can be used to define the parameters of all their available features. Setting parameters without Audio Tuning Tool (ATT) would be very time consuming, in some cases "impossible", and often the "manual" approach may result in sub-optimal product-performance or instabilities.

Some typical features supported by ATT is playback equalization, echo cancellation, noise suppression and beamformer tuning. Especially in the latest ANC product line, the high performance proprietary implementations of filter tuning will outperform any other alternative method of filter design.

Nomenclature	
ATT	Audio Tuning Tool
DSP	Digital Signal Processing
ANC	Active Noise Cancellation
GUI	Graphical User Interface
RAM	Random Access Memory

2. Audio Tuning Tool

The ATT provides different GUIs as plug-ins to the main tool. The plug-ins allow setting the system parameters and (fine) tuning features in offline and in real-time. In order to help customers to easily setup the ATT we provide ATT-specific workspaces to the development kits. If the development environment allows, command line tools, are also provided, that generate the configuration files (aka ATT map files). Those files allow reuse of the ATT workspaces, in case of any parameter/addresses changes in the firmware. This way the customer can make changes to the original firmware and re-use the files in the ATT workspace.

ATT work is mainly performed in two parts of the software: 1.the main tool that includes the instance table and 2. the plug-ins. The main tool provides an exhaustive table of tunable parameters in RAM and registers providing human-readable labels. The main work of the Audio Engineer is accomplished through the assistance of the suitable plugins that provide a comprehensive approach, visual and computational aids for the simplification of the tuning work.

UserLabel	SubSystem	Type [<size>]
ID	Common	DLGANC_IDENTIFIER [1]
Left_FeedBack_BiquadOutGain1	Left	DLGANC_GAIN_FIELD_Q4_12_BIT25 [1]
Left_FeedBack_BiquadOutGain2	Left	DLGANC_GAIN_FIELD_Q4_12_BIT25 [1]
Left_FeedBack_ComboGain	Left	DLGANC_GAIN_FIELD_Q4_20 [1]
Left_FeedBack_filter	Left	DLGANC_BIQUAD_FIELDS [6]
Left_FeedBack_UserGainInit	Left	DLGANC_GAIN_FIELD_Q1_15_BIT25 [1]

Figure 1: ATT main tool table with tunable parameters (DSP and registers)

2.1 ATT Plugins

The ATT provides a proprietary interface to DLLs that can be used as plugins and are specialized in the tuning of specific DSP functions that materialize as features for the end-product. More specifically ATT features plugins for the following operations:

- Tuning of Acoustic Echo Cancellers
- Tuning of Active Noise Cancelling
- Tuning of Endfire Beamformer
- Equalization
- Gain plan illustration
- Oscilloscope

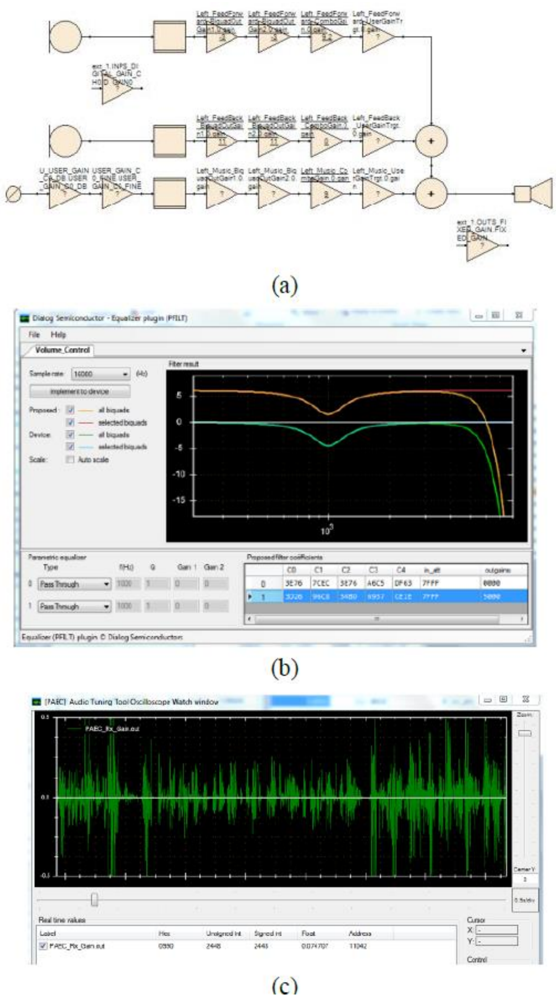


Figure 2: Interfaces for (a) Gain plan, (b) Equalizer and (c) Oscilloscope plugin

2.2 Cutting edge tuning tool automation

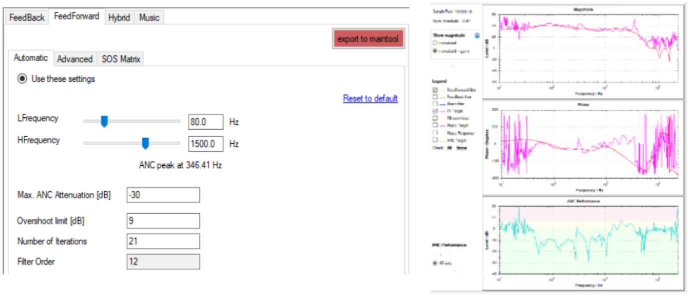
New generation of ATT offers a cutting-edge plugin for ANC tuning automation. It features a proprietary interface and back-end algorithms for providing the user with a powerful automatic ANC filter design tool.

Automatic ANC filter design reduces the effort and the experience required for achieving the optimal noise cancellation performance for the specific acoustics of a customer's device. This is achieved through optimal underlying exploitation of all the device's resources and reduction of human error via the exposition of only meaningful parameters to the user such as the frequency range and level of required ANC attenuation.

In order for the automatic ANC Plugin to operate, only a set of acoustic measurements is required by the user. Afterwards, the tuning is done with the control of ANC parameters using the intuitive plugin UI as shown in Fig.3(a).

Typically, the filter design for a given set of parameters, takes 3 – 15 seconds to execute, depending on the level of required precision. The results are shown in a graph, along with the estimated performance (Fig.3(b)). The algorithm ensures such precision to the user that can achieve "what you see is what you get" results in terms of measurable performance as it is illustrated in Fig.4.

All required hardware configurations are transparent to the user and executed with a press of a button. After this, the device is ready to go and confirm the noise cancelling estimation by measurements.



(a) (b)

Figure 3: Interfaces of the automatic ANC filter design plugin: (a) Tuning parameters, (b) Graphs illustrating magnitude, phase and performance of the designed filter

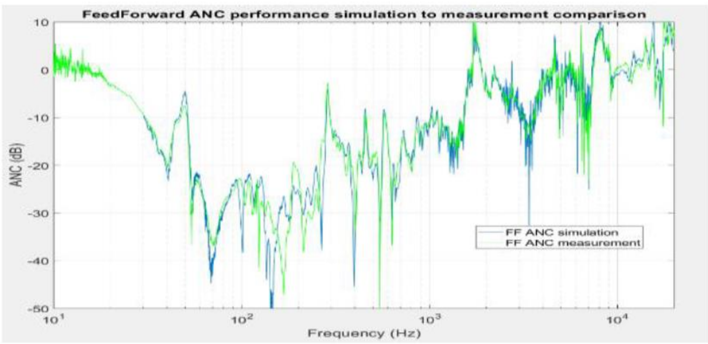


Figure 4: Estimated vs measured ANC performance

Future versions of ATT are expected to involve the automated approach in several features allowing for a faster time to market approach and the reduction of required resources for optimally defining the chip setup according to the customer requirements and product specs.

3. Conclusions

In the current work, a cutting-edge software platform ispresented. With the help of the software, customers can easily design filters and tune parameters for various audio filters and features available in DAxxxx series of Renesas audio codecs. The application can be used off line for design and simulation or in real time for evaluation of the results. The benefit will be short time to market development, high quality results of the proprietary automatic design methods, ease of use and reliable results.

References

[1] https://www.renesas.com/us/en/products/analog-products/audio-video/audio-codecs