Test procedures for verification of LUF

Executive summary

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# Revision history

|  |  |  |  |
| --- | --- | --- | --- |
| **Revision** | **Date** | **Description of changes** | **Author** |
| A | 2013-08-01 | Initial version, Template | Maria |
|  |  |  |  |
|  |  |  |  |

# Introduction

This document describes the different test procedures made to verify the signal processing routines in the TrueVoice library. The signal processing routines consist of the blocks noise reduction, voice activity detection (VAD), line echo cancellation (LEC), automatic gain control (AGC), directive hearing, channel mixer and limiter. The different blocks are first tested separately and the procedures are described under section 3. A test procedure for the whole system is also made and described in section 4.

# Test procedures for different blocks

## Noise reduction

The algorithm takes the speech microphone and noise microphone as input and updates the speech microphone with noise reduced and delayed by one block.

Special cases that need to be tested mare listed for either quality or stability include:

* Speech microphone is much louder.
* Noise microphone is much louder.
* Long speech without pauses.
* The microphones are moving relative to each other fast.
* Have noise source very close to the noise mick for a period of time, then remove it and see if the algorithm can adapt to that.
* Test with noise that have frequency response similar to voice (background mumble).
* Test different levels of SNR, eq. 0 – 18dB.

Cases that will not be tested for include faults in hardware that might occur.

## Voice activity detection

Test

## Line echo cancellation

Test

## Automatic gain control?

Test

## Directive Hearing

Test

## Channel mixer

When testing the mixer all other modules (AGC, Directive audio, LEC, Limiter, Noise reduction and VAD) are turned off. The system consists of 19 different input channels and 12 different output channels. To test the system a sin wave at a certain frequency is provided as input to each input channel, see Table 1 for the different frequencies. The default setting for the system is that all possibly channel connections are open. Therefore it is possibly to see which of the inserted frequencies that gets through as an output to each output channel. Table 2 shows what frequencies that should be at what output channel if the mixer is working correct.

Table 1. Input channels along with the frequency of the inserted sin wave.

|  |  |  |
| --- | --- | --- |
| **Input Name** | **Channel** | **Frequency** |
| Tech 1 | Rx 0 | 100 |
| Tech 2 | Rx 1 | 200 |
| Tech 3 | Rx 2 | 300 |
| Tech 4 | Rx 3 | 400 |
| Tech 5 | Rx 4 | 500 |
| Tech 6 | Rx 5 | 600 |
| Tech 7 | Rx 6 | 700 |
| Tech 8 | Rx 7 | 800 |
| MMI | Rx 8 | 900 |
| LMR | Rx 9 | 1000 |
| FTN | Rx 10 | 1100 |
| Pilot | Rx 11 | 1200 |
| CLT | Rx 12 | 1300 |
| CLT 4-wire | Rx 13 | 1400 |
| CLT 2-wire | Rx 14 | 1500 |
| Mic Noise | Mic 0 | 1600 |
| Tech Headset | Mic 1 | 1700 |
| Pilot Headset | Mic 2 | 1800 |
| Pilot Cable | Mic 3 | 1900 |

Table 2. Output channels along with frequencies of the sin waves from input in Table 1 that should have passed through the mixer if it is working correct. The table shows the output for the different communication modules PT, BS and CA. It also show the different cases on PT when the user is 1st technician or an ordinary technician.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Output Name** | **Channel** | **PT (1st tech)** | **PT (Tech)** | **BS** | **CA** |
| Tech to Radio | Tx 0 | 1700 | 1700 | 1700 | 1700 |
| Pilot to Radio | Tx 1 | - | - | 1800/1900 | - |
| FTN to Line | Tx 2 | - | - | 100, 1700, 1800/1900 | - |
| CLT to Line | Tx 3 | - | - | 1900 | - |
| LMR to Line | Tx 4 | - | - | 100 | - |
| FTN to Radio | Tx 5 | - | - | 1100 | - |
| CLT to Radio | Tx 6 | - | - | 1400/1500 | - |
| LMR to Radio | Tx 7 | - | - | 1000 | - |
| Tech Left | Ls 0 | 100, 200, 300, 400, 500, 600, 700, 900, 1000, 1100, 1200, 1300, 1700 | 100, 200, 300, 400, 500, 600, 700, 900, 1300, 1700 | - | 100, 200, 300, 400, 500, 600, 700, 900, 1700, 1800/1900 |
| Tech Right | Ls 1 | 100, 200, 300, 400, 500, 600, 700, 900, 1000, 1100, 1200, 1300, 1700 | 100, 200, 300, 400, 500, 600, 700, 900, 1300, 1700 | - | 100, 200, 300, 400, 500, 600, 700, 900, 1700, 1800/1900 |
| Tech Mono | Ls 2 | - | - | 100, 900, 1100, 1700 | - |
| Pilot Mono | Ls 3 | - | - | 100, 900, 1100, 1800/1900 | 900, 1700?, 1800/1900 |

When using the PT or the CA the eighth technician (Rx 7) is always chosen as ourselves. Rx 0 is 1st tech during the tests except for when we are 1st tech, 1st tech is then Rx 7 instead. Therefore 1st tech has a frequency of 100 Hz everywhere except for when we are 1st tech on PT, then 1st tech has 800 Hz as frequency. When a technician is connected with the headset to the CA then it is 1st technician by default. The technician’s headset mic is set to the pilot headset loudspeaker and as output to radio and technician on CA therefore has 1700 hz as frequency.

On some places in Table 2 the expression 1800/1900 and 1400/1500 has been used. The reason for this is that only one of the two signals representing these frequencies can be used depending on the settings of the system. 1800 or 1900 depends on which pilot connections that is used (headset jack or aircraft cable). 1400 or 1500 depends on which CLT connection that is used (2- or 4-wire). Both connections are not used at the same time.

The input channels shown in Table 1 are either external receive channels or microphone input from headset. DTMF signals are created internal in the system and the mixer also has two inputs regarding this, see Table 3 for mixer input and output channels. One channel is for sending the DTMF tones to the loudspeaker and one channel is for DTMF tones going out to line for making a call. Table 4 shows on which output channels the two different DTMF signals should be sent. To test if this is working correct, create a DTMF signal with the DTMF interface functions… and look at the output channels…

Table 3. Mixer input and output channels.

|  |  |
| --- | --- |
| **Mixer in** | **Mixer out** |
| Tech 1 | Tech left front |
| Tech 2 | Tech left back |
| Tech 3 | Tech right front |
| Tech 4 | Tech right back |
| Tech 5 | Tech center |
| Tech 6 | Tech mono |
| Tech 7 | Pilot mono |
| Tech 8 | LMR line |
| MMI | FTN line |
| LMR | CLT line |
| FTN | LMR radio |
| Pilot | FTN radio |
| CLT | CLT radio |
| Mic Tech | Pilot radio |
| Sidetone | Tech radio |
| DTMF Ls |  |
| DTMF Line |  |

Table 4. DTMF signals on output channels for the different communication modules.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Output Name** | **Channel** | **PT (1st tech)** | **PT (Tech)** | **BS** | **CA** |
| Tech to Radio | Tx 0 | - | - | - | - |
| Pilot to Radio | Tx 1 | - | - | - | - |
| FTN to Line | Tx 2 | - | - | DTMF line | - |
| CLT to Line | Tx 3 | - | - | - | - |
| LMR to Line | Tx 4 | - | - | - | - |
| FTN to Radio | Tx 5 | - | - | - | - |
| CLT to Radio | Tx 6 | - | - | - | - |
| LMR to Radio | Tx 7 | - | - | - | - |
| Tech Left | Ls 0 | DTMF ls | - | - | - |
| Tech Right | Ls 1 | DTMF ls | - | - | - |
| Tech Mono | Ls 2 | - | - | DTMF ls | - |
| Pilot Mono | Ls 3 | - | - | DTMF ls | - |

## Limiter?

Test

# Test procedure for the whole system