Adaptive Filter
Disturbance
detector
Response
extraction
Coefficients
envelope
compliance
Averaging
filters
OEM
IEM
Response
Extraction
And
Assertion
Filter
coefficients
Fit quality
value
Method 1 output
Response extraction and assertion, method 1
Filter coefficients
Envelope compliance
Response extraction and assertion, method 2
Averaging filters
(optional)
Method 2 output
Response extraction and assertion, method 2
Averaging
filters
(optional)
Method 3 output
Response extraction and assertion, method 3
Fit quality
value
(One of the method output)
Adaptation
activation
Filter coefficients
Highest filter coefficient
106
104
110
120
1246
1248
1212
1214
1210
1230
1214
1210
1250
Method 1 output
Method 2 output
Method 3 output
FIGURE 2

+
Perform FIR filter adaptation using NLMS for X seconds.

Reset all FIR filter coefficients to 0

Wait for in-between fit checks delay or user trigger. (delay can be 0)

Perform FIR filter adaptation using NLMS for X seconds.

Adapted FIR filter coefficients are within the stored good fit coefficient envelope

Fit OK

Fit BAD

GoodFitCount <= BadFitCeiling

Fit Test not conclusive

Fit OK

GoodFitCount >= GoodFitFloor

Fit Computed > FitToCompute

Make sure the case where FitToCompute = 1 is covered. This is to give a commercial value to the algorithm even if there is no averaging.

In one embodiment:
FitToCompute = 10
BadFitCeiling = 2
GoodFitFloor = 8

FIGURE 3
Perform FIR filter adaptation using NLMS for X seconds.

Extract frequency response of the bands between 150 and 350 Hz for the produced FIR filter adapted coefficients by computing FFT of the impulse response.

Compute the following values for each response:
- BandAverage: Average of band responses.
- CoherencyCurve: Coherency of response vs input.

Reset all FIR filter coefficients to 0.

Response Average is over a BadFit floor.
CoherencyCurves are over a threshold curve for all responses.

Adaptive Filter disturbance or inadequate audio environment detected during adaptation.

Insert BandAverage into Response Average.

Average contains Y iterations.

Fit Test not conclusive.

Fit BAD.

Fit OK.

Optional.

Response Average at this point can be used as a fit quality estimator, which can be seen as an output of the algorithm.

Wait for in-between fit checks delay or user trigger.

Reset Response Average to 0.

FIGURE 4
1. Method for the Continuous Assessment of the Fit of an In-Ear Wearable Device

1.1 Method for the Continuous Assessment of the Fit of an In-Ear Wearable Device using adaptive filtering

1.1.1 Method for the Continuous Assessment of the Fit of an In-Ear Wearable Device using NLMS adaptive filtering

1.1.2 via adapted filter frequency response extraction

1.1.3 via adapted filter coefficients envelope matching

1.1.4 with improved reliability by combining 1.1.2 and 1.1.3

1.1.2.1 with improved reliability by adding average filtering stage and sequence

1.1.3.1 with improved reliability by adding accumulated fit responses sequence

FIGURE 5
**FIGURE 11E**

$2000\text{Hz}, R^2 = 0.40327$

**FIGURE 11F**

$4000\text{Hz}, R^2 = 0.42083$