Claims

1. A self-tuned apparatus for controlling noise actively by compensating for at least one secondary path non-linearity caused by at least one saturation effect in an active noise control system, said apparatus comprising:

a first transducer and a second transducer, said first transducer being electrically coupled to said second transducer, wherein said first transducer and said second transducer are configured to receive a first acoustic signal and a second acoustic signal respectively;

a noise controlling module coupled to said first transducer and said second transducer, wherein said noise controlling module employs at least one control algorithm;

at least one power amplifier coupled to said noise controlling module; and

a first loudspeaker and a second loudspeaker coupled to said power amplifier,

wherein said apparatus is configured for modeling a nonlinear secondary path and allows estimation of a degree of nonlinearity to be implemented in said noise controlling module;

said nonlinear secondary path and the degree of nonlinearity are modeled using tangential hyperbolic function (THF); and

modeling of said at least one secondary path non-linearity with saturation nonlinearity is performed by selecting one of a Hammerstein model structure and a Wiener model structure in the presence of at least one of said first loudspeaker and said second loudspeaker and/or said power amplifier.

2. The apparatus of claim 1, wherein said active noise control system comprises feedforward architectures and feedback architectures for both single systems and multivariable systems.

3. The apparatus of claim 2, wherein said first transducer and said second transducer are a microphone.

4. The apparatus of claim 1, wherein said at least one control algorithm is nonlinear Filtered-X Least Mean Square (NLFXLMS) family of algorithms.

5. The apparatus of claim 1, wherein said at least one control algorithm determined is Leaky FXLMS family of algorithms and/or Minimum output variance FXLMS family of algorithms.

6. A self-tuned apparatus for controlling noise actively by compensating for at least one secondary path non-linearity caused by at least one saturation effect in an active noise control system, said apparatus comprising:

a first transducer and a second transducer, said first transducer being electrically coupled to said second transducer, wherein said first transducer and said second transducer are configured to receive a first acoustic signal and a second acoustic signal respectively;

a noise controlling module coupled to said first transducer and said second transducer, wherein said noise controlling module employs at least one control algorithm;

at least one power amplifier coupled to said noise controlling module; and

a first loudspeaker and a second loudspeaker coupled to said power amplifier,

wherein said at least one control algorithm determined is Leaky FXLMS family of algorithms and/or Minimum output variance FXLMS family of algorithms;

said Minimum output variance FXLMS family of algorithms and/or said Leaky FXLMS family algorithms are implemented using a degree of nonlinearity modeled using tangential hyperbolic function (THF).

7. The apparatus of claim 6, wherein said apparatus is configured for modeling a nonlinear secondary path and allows estimation of said degree of nonlinearity to be implemented in said noise controlling module.

8. The apparatus of claim 7, wherein said nonlinear secondary path is modeled using THF.

9. The apparatus of claim 6, wherein said active noise control system comprises feedforward architectures and feedback architectures for both single systems and multivariable systems.

10. The apparatus of claim 9, wherein said first transducer and said second transducer are a microphone.

11. A self tuned method for controlling active noise by compensating for at least one secondary path non-linearity caused by at least one saturation effect in an active noise control system, said method comprising the steps of:

modeling said at least one secondary path non-linearity with saturation nonlinearity in at least one of a loudspeaker and/or a power amplifier;

evaluating a degree of nonlinearity from an identified secondary path model;

determining at least one control algorithm for saturation nonlinearity in said at least one of said loudspeaker and/or said power amplifier;

said at least one control algorithm determined is nonlinear FXLMS family of algorithms; and

iteratively designing the nonlinear FXLMS family of algorithms using an information of said degree of nonlinearity until a noise controlling module converges; and

applying said noise controlling module to reduce noise heard by a subject user.

12. The method of claim 11, wherein a nonlinear secondary path and said degree of nonlinearity are modeled using tangential hyperbolic function (THF).

13. A self-tuned method for controlling active noise by compensating for at least one secondary path non-linearity caused by at least one saturation effect in an active noise control system said method comprising the steps of:

modeling said at least one secondary path non-linearity with saturation nonlinearity in at least one of a loudspeaker and/or a power amplifier.

evaluating a degree of nonlinearity from an identified secondary path model;

determining at least one control algorithm for saturation nonlinearity in said at least one of said loudspeaker and/or said power amplifier;

said at least one control algorithm determined is Leaky FXLMS family of algorithms and/or Minimum output variance FXLMS family of algorithms;

collecting an output signal from a primary path;

computing an energy of the collected output signal from said primary path;

computing an optimum leakage factor using said energy of said output signal of said primary path and said degree of nonlinearity;

applying an optimal leakage factor in forming at least one of said Leaky FXLMS family algorithms and said Minimum output variance FXLMS family of algorithms; and

storing said Leaky FXLMS family algorithms and/or said Minimum output variance FXLMS family of algorithms in a processor of a noise controlling module.

14. The method of claim 13, wherein said active noise control system comprises feedforward architectures and feedback architectures for both single systems and multivariable systems.

15. The method of claim 13, wherein a nonlinear secondary path and said degree of nonlinearity are modeled using tangential hyperbolic function (THF).

16. A self-tuned method for controlling active noise by compensating for at least one secondary path non-linearity caused by at least one saturation effect in an active noise control system, said method comprising the steps of:

modeling said at least one secondary path non-linearity with saturation nonlinearity in at least one of a loudspeaker and/or a power amplifier;

evaluating a degree of nonlinearity from an identified secondary path model;

determining at least one control algorithm for saturation nonlinearity in said at least one of said loudspeaker and/or said power amplifier,

wherein modeling said at least one secondary path non-linearity with saturation nonlinearity is performed by selecting one of a Hammerstein model structure and a Wiener model structure in the presence of said at least one of said loudspeaker and/or said power amplifier.

17. The method of claim 16, wherein said at least one control algorithm determined is nonlinear FXLMS family of algorithms.

18. The method of claim 16, wherein said at least one control algorithm determined is Leaky FXLMS family of algorithms and/or Minimum output variance FXLMS family of algorithms.

19. The method of claim 16, wherein said active noise control system comprises feedforward architectures and feedback architectures for both single systems and multivariable systems.

20. The method of claim 16, wherein a nonlinear secondary path and said degree of nonlinearity are modeled using tangential hyperbolic function (THF).