CLAIMS

1. A method for processing multi-channel audio signals for surround sound production on a plurality of loudspeakers to a listening area, the plurality of loudspeakers being front located with respect to the listening area, the plurality of loudspeakers comprising an outer left loudspeaker, an inner left loudspeaker, an inner right loudspeaker and an outer right loudspeaker, the multi-channel audio signals comprising one or more low frequency effects audio signals and one or more audio signals that are front based left inclined, front based right inclined, rear based left inclined, rear based right inclined, and centre based, the method comprising:

(a) adjusting phase and amplitude of the one or more audio signals that are rear based left inclined to produce one or more time delayed and amplitude adjusted rear left signals;

(b) adjusting phase and amplitude of the one or more audio signals that are rear based right inclined to produce one or more time delayed and amplitude adjusted rear right signals;

(c) adjusting amplitude of the one or more audio signals that are rear based left inclined to produce one or more amplitude adjusted rear left signals;

(d) adjusting amplitude of the one or more audio signals that are rear based right inclined to produce one or more amplitude adjusted rear right signals;

(e) filtering the one or more time delayed and amplitude adjusted rear right signals, the one or more amplitude adjusted rear left signals and the one or more audio signals that are front based left inclined, the filtering of step (e) comprising dampening of high frequency components of the signals being filtered;

(f) filtering the one or more time delayed and amplitude adjusted rear left signals, the one or more amplitude adjusted rear right signals and the one or more audio signals that are front based right inclined, the filtering of step (f) comprising dampening of high frequency components of the signals being filtered;

(g) adjusting the phase of the one or more time delayed and amplitude adjusted rear right signals, the one or more amplitude adjusted rear left signals and the one or more audio signals that are front based left inclined to introduce a time delay to each of them;

(h) adjusting the phase of the one or more time delayed and amplitude adjusted rear left signals, the one or more amplitude adjusted rear right signals and the one or more audio signals that are front based right inclined to introduce a time delay to each of them;

(i) transmitting the one or more audio signals that are front based left inclined, the one or more audio signals that are rear based left inclined and all the adjusted signals at step (g) to the outer left loudspeaker;

(j) transmitting the one or more audio signals that are front based right inclined, the one or more audio signals that are rear based right inclined and all the adjusted signals at step (h) to the outer right loudspeaker;

(k) transmitting the one or more audio signals that are centre based and all the filtered signals at step (e) to the inner left loudspeaker; and

(l) transmitting the one or more audio signals that are centre based and all the filtered signals at step (f) to the inner right loudspeaker.

2. The method as claimed in claim 1, the method further comprising:

transmitting the one or more low frequency effects audio signals to a subwoofer of the plurality of loudspeakers for audio bass production.

3. The method as claimed in claim 1, the method further comprising:

low pass filtering each of the multi-channel audio signals;

high pass filtering each of the multi-channel audio signals except the one or more low frequency effects audio signals before commencement of steps (i), (j), (k) and (l); and

transmitting each of the low pass filtered multi-channel audio signals to a subwoofer of the plurality of loudspeakers for audio bass production,

wherein the filtering of steps (e) and (f) comprising high pass filtering the signals being filtered at steps (e) and (f).

4. The method as claimed in claim 1, wherein adjusting amplitude at steps (a) and (b) adjusts said signals by a first scaling factor in the range of 0.35 to 0.75.

5. The method as claimed in claim 1, wherein adjusting amplitude at steps (c) and (d) adjusts said signals by a second scaling factor in the range of 0.7 to 1.5.

6. The method as claimed in claim 1, the method further comprising adjusting amplitude of the one or more audio signals that are front based left inclined and front based right inclined by a third scaling factor in the range of 0.5 to 1.

7. The method as claimed in claim 1, the method further comprising:

adjusting amplitude of the one or more audio signals that are centre based by negative 3 decibels.

8. The method as claimed in claim 1, the method further comprising steps for converting stereo channel audio signals into audio input signals for surround sound production on the plurality of loudspeakers, the steps comprising:

providing the left channel audio signal of the stereo channel audio signals as a front based left inclined audio signal of the multi-channel audio signals;

providing the right channel audio signal of the stereo channel audio signals as a front based right inclined audio signal of the multi-channel audio signals; and

providing zero signal as each of the one or more low frequency effects audio signal and each of the one or more audio signals that are centre based, rear based left inclined, and rear based right inclined.

9. An audio system for processing multi-channel audio signals for surround sound production on a plurality of loudspeakers to a listening area, the plurality of loudspeakers being front located with respect to the listening area, the plurality of loudspeakers comprising an outer left loudspeaker, an inner left loudspeaker, an inner right loudspeaker and an outer right loudspeaker, the multi-channel audio signals comprising one or more low frequency effects audio signals and one or more audio signals that are front based left inclined, front based right inclined, rear based left inclined, rear based right inclined, and centre based, the audio system comprising:

first adjusting means for adjusting phase and amplitude of the one or more audio signals that are rear based left inclined to produce one or more time delayed and amplitude adjusted rear left signals;

second adjusting means for adjusting phase and amplitude of the one or more audio signals that are rear based right inclined to produce one or more time delayed and amplitude adjusted rear right signals;

first scaling means for adjusting amplitude of the one or more audio signals that are rear based left inclined to produce one or more amplitude adjusted rear left signals;

second scaling means for adjusting amplitude of the one or more audio signals that are rear based right inclined to produce one or more amplitude adjusted rear right signals;

first filtering means for filtering the one or more time delayed and amplitude adjusted rear right signal, the one or more amplitude adjusted rear left signal and the one or more audio signals that are front based left inclined, the high frequency components of the signals being dampened by the first filtering means;

second filtering means for filtering the one or more time delayed and amplitude adjusted rear left signal, the one or more amplitude adjusted rear right signal and the one or more audio signals that are front based right inclined, the high frequency components of the signals being dampened by the second filtering means;

first phase adjusting means for adjusting the phase of the one or more time delayed and amplitude adjusted rear right signal, the one or more amplitude adjusted rear left signal and the one or more audio signals that are front based left inclined to introduce a time delay in each of them; and

second phase adjusting means for adjusting the phase of the one or more time delayed and amplitude adjusted rear left signal, the one or more amplitude adjusted rear right signal and the one or more audio signals that are front based right inclined to introduce a time delay in each of them, the outer left loudspeaker receiving the one or more audio signals that are front based left inclined, the one or more signals that are rear based left inclined and all the signals adjusted by the first phase adjusting means,

the outer right loudspeaker receiving the one or more audio signals that are front based right inclined, the one or more signals that are rear based right inclined and all the signals adjusted by the second phase adjusting means,

the inner left loudspeaker receiving the one or more audio signals that are centre based and all the signals adjusted by the first filtering means, and

the inner right loudspeaker receiving the one or more audio signals that are centre based and all the signals adjusted by the second filtering means.

10. The audio system as claimed in claim 10, the audio system further comprising a subwoofer receiving the one or more low frequency effects audio signals for audio bass production.

11. The audio system as claimed in claim 10, the audio system further comprising:

low pass filtering means for filtering each of the multi-channel audio signals;

high pass filtering means for filtering each of the multi-channel audio signals except the one or more low frequency effects audio signals before the outer left loudspeaker, the outer right loudspeaker, the inner left loudspeaker and the inner right loudspeaker receive any audio signals; and

a subwoofer receiving each of the low pass filtered multi-channel audio signals for audio bass production,

wherein the filtering carried out by the first filtering means and the second filtering means being high pass filtering.

12. The audio system as claimed in claim 10, the first adjusting means and the second adjusting means adjusting the amplitude of the respective signals by a first scaling factor in the range of 0.35 to 0.75.

13. The audio system as claimed in claim 10, the first scaling means and the second scaling means adjusting the amplitude of the respective signals by a second scaling factor in the range of 0.7 to 1.5.

14. The audio system as claimed in claim 10, the audio system further comprising third scaling means for adjusting the amplitude of the one or more audio signals that are front based left inclined and front based right inclined by a third scaling factor in the range of 0.5 to 1.

15. The audio system as claimed in claim 10, wherein the amplitude of the one or more audio signals that are centre based being scaled by negative 3 decibels.

16. The audio system as claimed in claim 10, in the conversion of stereo channel audio signals into audio input signals for surround sound production on the plurality of loudspeakers,

the left channel audio signal of the stereo channel audio signals being provided as a front based left inclined audio signal of the multi-channel audio signals,

the right channel audio signal of the stereo channel audio signals being provided as a front based right inclined audio signal of the multi-channel audio signals, and

zero signal being provided as each of the one or more low frequency effects audio signal and each of the one or more audio signals that are centre based, rear based left inclined, and rear based right inclined.

17. The audio system as claimed in claim 10, the outer left loudspeaker, the inner left loudspeaker, the outer right loudspeaker and the inner right loudspeaker facing the listening area and being spaced along a speaker axis defined as a line passing through the outer left, the inner left, the inner right and the outer right locations of said loudspeakers.

18. The audio system as claimed in claim 11, wherein the subwoofer is located between the inner left loudspeaker and the inner right loudspeaker.

19. The audio system as claimed in claim 12, wherein the subwoofer is located between the inner left loudspeaker and the inner right loudspeaker.

20. The audio system as claimed in claim 10, wherein

a first plane on which the outer left loudspeaker is mounted on being arranged at a first angle relative to a second plane on which the inner left loudspeaker is mounted on; and

a third plane on which the outer right loudspeaker is mounted on being arranged at a second angle relative to a fourth plane on which the inner right loudspeaker is mounted on.

21. The audio system as claimed in claim 21, wherein the outer left loudspeaker or the outer right loudspeaker is stacked on top or below the inner left loudspeaker or the inner right loudspeaker respectively.

22. The audio system as claimed in claim 21, wherein each of the first angle and the second angle being in the range of 90 to 180 degrees.

23. The audio system as claimed in claim 21, wherein value of each of the first angle or the second angle varies.

24. The audio system as claimed in claim 10, the plurality of loudspeakers being contained within a single enclosure.

25. A Digital Signal Processor for carrying out the method as claimed in claim 1.

The invention claimed is:

1. A method for processing multi-channel audio signals for surround sound production on a plurality of loudspeakers to a listening area, the plurality of loudspeakers being front located with respect to the listening area, the plurality of loudspeakers comprising an outer left loudspeaker, an inner left loudspeaker, an inner right loudspeaker and an outer right loudspeaker, the multi-channel audio signals comprising one or more low frequency effects audio signals and one or more audio signals that are front based left inclined, front based right inclined, rear based left inclined, rear based right inclined, and centre based, the method comprising:

(a) adjusting phase and amplitude of the one or more audio signals that are rear based left inclined to produce one or more time delayed and amplitude adjusted rear left signals;

(b) adjusting phase and amplitude of the one or more audio signals that are rear based right inclined to produce one or more time delayed and amplitude adjusted rear right signals;

(c) adjusting amplitude of the one or more audio signals that are rear based left inclined to produce one or more amplitude adjusted rear left signals;

(d) adjusting amplitude of the one or more audio signals that are rear based right inclined to produce one or more amplitude adjusted rear right signals;

(e) filtering the one or more time delayed and amplitude adjusted rear right signals, the one or more amplitude adjusted rear left signals and the one or more audio signals that are front based left inclined, the filtering of step (e) comprising dampening of high frequency components of the signals being filtered;

(f) filtering the one or more time delayed and amplitude adjusted rear left signals, the one or more amplitude adjusted rear right signals and the one or more audio signals that are front based right inclined, the filtering of step (f) comprising dampening of high frequency components of the signals being filtered;

(g) adjusting the phase of the one or more time delayed and amplitude adjusted rear right signals, the one or more amplitude adjusted rear left signals and the one or more audio signals that are front based left inclined to introduce a time delay to each of them;

(h) adjusting the phase of the one or more time delayed and amplitude adjusted rear left signals, the one or more amplitude adjusted rear right signals and the one or more audio signals that are front based right inclined to introduce a time delay to each of them;

(i) transmitting the one or more audio signals that are front based left inclined, the one or more audio signals that are rear based left inclined and all the adjusted signals at step (g) to the outer left loudspeaker;

(j) transmitting the one or more audio signals that are front based right inclined, the one or more audio signals that are rear based right inclined and all the adjusted signals at step (h) to the outer right loudspeaker;

(k) transmitting the one or more audio signals that are centre based and all the filtered signals at step (e) to the inner left loudspeaker; and

(l) transmitting the one or more audio signals that are centre based and all the filtered signals at step (f) to the inner right loudspeaker.

2. The method as claimed in claim 1, the method further comprising: transmitting the one or more low frequency effects audio signals to a subwoofer of the plurality of loudspeakers for audio bass production.

3. The method as claimed in claim 1, the method further comprising:

low pass filtering each of the multi-channel audio signals;

high pass filtering each of the multi-channel audio signals except the one or more low frequency effects audio signals before commencement of steps (i), (j), (k) and (l); and

transmitting each of the low pass filtered multi-channel audio signals to a subwoofer of the plurality of loudspeakers for audio bass production,

wherein the filtering of steps (e) and (f) comprising high pass filtering the signals being filtered at steps (e) and (f).

4. The method as claimed in claim 1, wherein adjusting amplitude at steps (a) and (b) adjusts said signals by a first scaling factor in the range of 0.35 to 0.75.

5. The method as claimed in claim 1, wherein adjusting amplitude at steps (c) and (d) adjusts said signals by a second scaling factor in the range of 0.7 to 1.5.

6. The method as claimed in claim 1, the method further comprising adjusting amplitude of the one or more audio signals that are front based left inclined and front based right inclined by a third scaling factor in the range of 0.5 to 1.

7. The method as claimed in claim 1, the method further comprising: adjusting amplitude of the one or more audio signals that are centre based by negative 3 decibels.

8. The method as claimed in claim 1, the method further comprising steps for converting stereo channel audio signals into audio input signals for surround sound production on the plurality of loudspeakers, the steps comprising:

providing the left channel audio signal of the stereo channel audio signals as a front based left inclined audio signal of the multi-channel audio signals;

providing the right channel audio signal of the stereo channel audio signals as a front based right inclined audio signal of the multi-channel audio signals; and

providing zero signal as each of the one or more low frequency effects audio signal and each of the one or more audio signals that are centre based, rear based left inclined, and rear based right inclined.

9. An audio system for processing multi-channel audio signals for surround sound production on a plurality of loudspeakers to a listening area, the plurality of loudspeakers being front located with respect to the listening area, the plurality of loudspeakers comprising an outer left loudspeaker, an inner left loudspeaker, an inner right loudspeaker and an outer right loudspeaker, the multi-channel audio signals comprising one or more low frequency effects audio signals and one or more audio signals that are front

based left inclined, front based right inclined, rear based left inclined, rear based right inclined, and centre based, the audio system comprising:

first adjusting means for adjusting phase and amplitude of the one or more audio signals that are rear based left inclined to produce one or more time delayed and amplitude adjusted rear left signals;

second adjusting means for adjusting phase and amplitude of the one or more audio signals that are rear based right inclined to produce one or more time delayed and amplitude adjusted rear right signals;

first scaling means for adjusting amplitude of the one or more audio signals that are rear based left inclined to produce one or more amplitude adjusted rear left signals;

second scaling means for adjusting amplitude of the one or more audio signals that are rear based right inclined to produce one or more amplitude adjusted rear right signals;

first filtering means for filtering the one or more time delayed and amplitude adjusted rear right signal, the one or more amplitude adjusted rear left signal and the one or more audio signals that are front based left inclined, the high frequency components of the signals being dampened by the first filtering means;

second filtering means for filtering the one or more time delayed and amplitude adjusted rear left signal, the one or more amplitude adjusted rear right signal and the one or more audio signals that are front based right inclined, the high frequency components of the signals being dampened by the second filtering means;

first phase adjusting means for adjusting the phase of the one or more time delayed and amplitude adjusted rear right signal, the one or more amplitude adjusted rear left signal and the one or more audio signals that are front based left inclined to introduce a time delay in each of them; and

second phase adjusting means for adjusting the phase of the one or more time delayed and amplitude adjusted rear left signal, the one or more amplitude adjusted rear right signal and the one or more audio signals that are front based right inclined to introduce a time delay in each of them, the outer left loudspeaker receiving the one or more audio signals that are front based left inclined, the one or more signals that are rear based left inclined and all the signals adjusted by the first phase adjusting means,

the outer right loudspeaker receiving the one or more audio signals that are front based right inclined, the one or more signals that are rear based right inclined and all the signals adjusted by the second phase adjusting means,

the inner left loudspeaker receiving the one or more audio signals that are centre based and all the signals adjusted by the first filtering means, and

the inner right loudspeaker receiving the one or more audio signals that are centre based and all the signals adjusted by the second filtering means.

10. The audio system as claimed in claim 9, the audio system further comprising a subwoofer receiving the one or more low frequency effects audio signals for audio bass production.

11. The audio system as claimed in claim 9, the audio system further comprising:

low pass filtering means for filtering each of the multi-channel audio signals;

high pass filtering means for filtering each of the multi-channel audio signals except the one or more low frequency effects audio signals before the outer left loudspeaker, the outer right loudspeaker, the inner left loudspeaker and the inner right loudspeaker receive any audio signals; and

a subwoofer receiving each of the low pass filtered multi-channel audio signals for audio bass production,

wherein the filtering carried out by the first filtering means and the second filtering means being high pass filtering.

12. The audio system as claimed in claim 9, the first adjusting means and the second adjusting means adjusting the amplitude of the respective signals by a first scaling factor in the range of 0.35 to 0.75.

13. The audio system as claimed in claim 9, the first scaling means and the second scaling means adjusting the amplitude of the respective signals by a second scaling factor in the range of 0.7 to 1.5.

14. The audio system as claimed in claim 9, the audio system further comprising third scaling means for adjusting the amplitude of the one or more audio signals that are front based left inclined and front based right inclined by a third scaling factor in the range of 0.5 to 1.

15. The audio system as claimed in claim 9, wherein the amplitude of the one or more audio signals that are centre based being scaled by negative 3 decibels.

16. The audio system as claimed in claim 9, in the conversion of stereo channel audio signals into audio input signals for surround sound production on the plurality of loudspeakers,

the left channel audio signal of the stereo channel audio signals being provided as a front based left inclined audio signal of the multi-channel audio signals,

the right channel audio signal of the stereo channel audio signals being provided as a front based right inclined audio signal of the multi-channel audio signals, and

zero signal being provided as each of the one or more low frequency effects audio signal and each of the one or more audio signals that are centre based, rear based left inclined, and rear based right inclined.

17. The audio system as claimed in claim 9, the outer left loudspeaker, the inner left loudspeaker, the outer right loudspeaker and the inner right loudspeaker facing the listening area and being spaced along a speaker axis defined as a line passing through the outer left, the inner left, the inner right and the outer right locations of said loudspeakers.

18. The audio system as claimed in claim 10, wherein the subwoofer is located between the inner left loudspeaker and the inner right loudspeaker.

19. The audio system as claimed in claim 11, wherein the subwoofer is located between the inner left loudspeaker and the inner right loudspeaker.

20. The audio system as claimed in claim 9, wherein

a first plane on which the outer left loudspeaker is mounted on being arranged at a first angle relative to a second plane on which the inner left loudspeaker is mounted on; and

a third plane on which the outer right loudspeaker is mounted on being arranged at a second angle relative to a fourth plane on which the inner right loudspeaker is mounted on.

21. The audio system as claimed in claim 20, wherein the outer left loudspeaker or the outer right loudspeaker is stacked on top or below the inner left loudspeaker or the inner right loudspeaker respectively.

22. The audio system as claimed in claim 20, wherein each of the first angle and the second angle being in the range of 90 to 180 degrees.

23. The audio system as claimed in claim 20, wherein value of each of the first angle or the second angle varies.

24. The audio system as claimed in claim 9, the plurality of loudspeakers being contained within a single enclosure.