

## CLAIMS

We claim:

1. A method comprising:
  - i) a mid-air haptic feedback system producing an acoustic field from a transducer array having known relative positions and orientations;
  - ii) the mid-air haptic feedback system defining a plurality of control points wherein each of the plurality of control points has a known spatial relationship relative to the transducer array and has a control point activation coefficient;
  - iii) the mid-air haptic feedback system calculating a complex wave field sample matrix at a plurality of control point positions of a first index;
  - iv) the mid-air haptic feedback system actuating at control point positions of a second index preset amplitude and zero phase offset control points;
  - v) the mid-air haptic feedback system calculating an eigenvector based on the complex wave field sample matrix; and
  - vi) the mid-air haptic feedback system adjusting the eigenvector to represent a plurality of control point activation coefficients.
2. The method as in claim 1, wherein the elements of the complex wave field sample matrix are calculated by the mid-air haptic feedback system through scaled products of stored optimal transducer activation vectors.
3. The method as in claim 1, wherein the eigenvector is weighted by the mid-air haptic feedback system to substantially reproduce the amplitude of each of the plurality of control points.
4. The method as in claim 3, wherein adjusting the eigenvector to represent a plurality of control point activation coefficients comprises the mid-air haptic feedback system using a power iteration where an arbitrary non-zero sample vector is multiplied and then normalized iteratively.

5. The method as in claim 3, wherein adjusting the eigenvector to represent a plurality of control point activation coefficients by the mid-air haptic feedback system is based on the power levels producible by the transducer array.

6. The method as in claim 3, wherein the eigenvector associated with the plurality of control points is calculated by the mid-air haptic feedback system prior to producing an acoustic field from a transducer array having known relative positions and orientations.

7. The method as in claim 1, wherein calculating an eigenvector by the mid-air haptic feedback system based on the complex wave field sample matrix uses a Cholesky decomposition.

8. The method as in claim 7, wherein the transducer array comprises a plurality of transducers and wherein the step of calculating an amplitude for each of the plurality of control points is made by the mid-air haptic feedback system with fewer than all of the plurality of transducers.

9. A method comprising:

i) a mid-air haptic feedback system producing an acoustic field from a transducer array having a plurality of transducers, wherein each of the plurality of transducers has known relative positions and orientations and wherein the acoustic field contains a carrier wave and a modulated signal;

ii) wherein each of the plurality of transducers is assigned an activation coefficient by the mid-air haptic feedback system in the complex space to define the frequency of the carrier wave;

iii) defining a plurality of control points by the mid-air haptic feedback system wherein each of the plurality of control points has a known spatial relationship relative to the transducer array; and

iv) focusing the carrier wave and the modulated signal at the plurality of control points by the mid-air haptic feedback system by smooth interpolation of the activation coefficient assigned to each of the plurality of transducers.

10. The method as in claim 9, wherein the focusing the carrier wave and each frequency of the modulated signal by the mid-air haptic feedback system results in a region of the haptic field with less audible noise than a preset threshold.

11. The method as in claim 9 wherein the focusing the carrier wave and each frequency of the modulated signal by the mid-air haptic feedback system results in a region containing haptic feedback greater than a preset threshold.

12. The method as in claim 9, further comprising a base clock for outputting the carrier wave and a pattern clock for outputting the modulated signal and wherein the focusing the carrier wave and the modulated signal by the mid-air haptic feedback system occurs by adjusting the pattern clock with respect to the base clock.

13. The method as in claim 9 further comprising a preprocessing step to produce an eigenvector solution for the complex pressure value for each region by the mid-air haptic feedback system given an arbitrary transducer array having discrete transducer elements.