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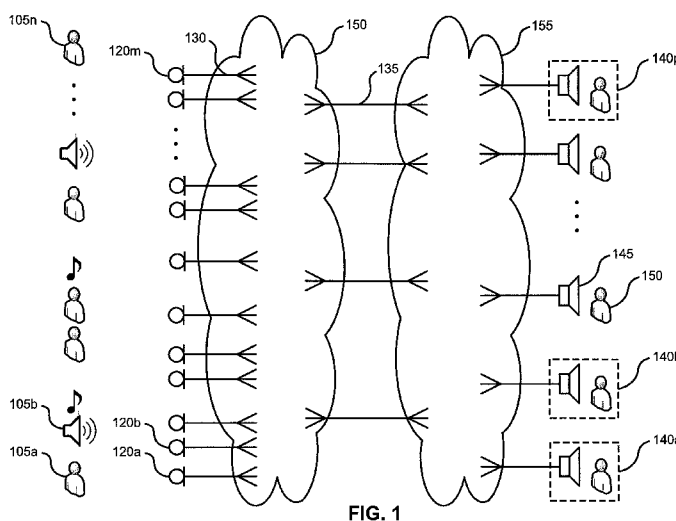
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(54) Title: DISTRIBUTED BLIND SOURCE SEPARATION**FIG. 1**

(57) **Abstract:** Systems and methods for using distributed processing in conjunction with blind source separation techniques for signal processing and acquisition in sensor network environments are provided. In the distributed blind source separation framework, sensors perform processing of sensor signals rather than transmit such signals over long distances, and/or outside of the sensor network, for processing at a central location. Sensors attempt to own a source signal, and a source signal can only be owned by one active sensor. Sensors owning a source signal broadcast the signal directly or indirectly so that it is perceived by users. Sensors receive information from other sensors in their sensor neighborhood, including observed signals of the other sensors and estimated source signals of sources owned by the other sensors. Owning sensors extract the respective source signals associated with the sources they own and redundant sensors can check for any non-owned source signals present.



AMENDED CLAIMS

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1. A method for processing signals in a sensor network, the sensor network including a plurality of sensors each sensor being in a state of an owning sensor or non-owning sensor, the method comprising:

establishing, by a non-owning sensor in the network, a neighborhood of owning sensors, each of the owning sensors owning a specific source signal from amongst a plurality of source signals generated from sources;

obtaining, by the non-owning sensor, signal information from the owning sensors in the neighborhood of owning sensors;

comparing, by the non-owning sensor, based on the signal information, a signal reception strength of an owning sensor over a specific source signal owed by the owning sensor with a signal reception strength of the non-owning sensor over the specific source signal; and

based on the comparison of the signal reception strengths, the non-owning sensor taking ownership of the specific source signal.

2. The method of claim 1, wherein the signal information from the owning sensors include extracted source signals and sensor signals from each of the owning sensors in the neighborhood.

3. The method of claim 2, wherein the extracted source signals are estimates of the source signals generated from the sources.

4. The method of claim 1, wherein each of the owning sensors broadcasts the specific source signal to a plurality of sensors in the network.

5. The method of claim 1, wherein each of the owning sensors broadcasts the specific source signal directly or via a relay node over a radio network to a user.
6. The method of claim 5, wherein the plurality of sensors are local to the sources, and wherein the user is remote from the plurality of sensors.
7. The method of claim 5, wherein the plurality of sensors are local to the sources, and wherein both the plurality of sensors and the sources are local to the user.
8. The method of claim 1, further comprising:
 - determining by the non-owning sensor, based on the signal information, that all source signals of a plurality of source signals generated from the sources are owned; and
 - in response to determining all of the source signals are owned, the non-owning sensor deactivating.
9. The method of claim 1, further comprising:
 - determining, by the non-owning sensor, based on the signal information, that a source signal of a plurality of source signals generated from the sources is unowned; and
 - the non-owning sensor taking ownership of the unowned source signal.
10. A method for processing signals in a sensor network, the sensor network including a plurality of sensors each sensor being in a state of an owning sensor or non-owning sensor, the method comprising:

updating, by an owning sensor, a sensor neighborhood of the owning sensor, the sensor neighborhood including other owning sensors each owning a specific source signal from amongst a plurality of source signals generated from sources;

acquiring, by the owning sensor, extracted source signals and sensor signals communicated by the other owning sensors in the updated sensor neighborhood;

extracting, by the owning sensor, the specific source signal owned by the owning sensor; and

transmitting by the owning sensor, a communication to the updated sensor neighborhood, the communication including the extracted source signal owned by the owning sensor and a sensor signal of the owning sensor.

11. The method of claim 10, wherein extracting the specific source signal includes estimating the specific source signal owned by the owning sensor.

12. The method of claim 11, wherein estimating the specific source signal includes:

analyzing, by the owning sensor, sequentially overlapping windowed multi-channel signal segments for a plurality of signals in the updated sensor neighborhood; and

identifying, from separated source signal sets computed for the sequentially overlapping signal segments, corresponding source signals to obtain an estimate of the specific source signal owned by the owning sensor across sequential signal segments.

13. The method of claim 10, wherein each of the extracted source signals is an estimate of a specific source signal of the plurality generated by the sources.

14. The method of claim 10, wherein each of the sensor signals includes a measure of reception strength of the specific source signal owned by the other owning sensor.
15. The method of claim 10, further comprising the owning sensor transitioning to the non-owning state in response to determining a strength of ownership over the specific source signal owned by the owning sensor is below a threshold level.
16. The method of claim 10, further comprising:
- determining a signal reception strength of the owning sensor for the specific source signal owned by the owning sensor;
 - comparing the signal reception strength of the owning sensor with a signal reception strength of a non-owning sensor for the specific source signal; and
 - deactivating the owning sensor based on the comparison of the signal reception strengths.
17. The method of claim 10, further comprising the owning sensor broadcasting the extracted source signal owned by the owning sensor directly or via a relay node over a radio network to a user.
18. The method of claim 17, wherein the sources are local to the owning sensor, and wherein the user is remote from the owning sensor.
19. The method of claim 17, wherein the sources are local to the owning sensor, and wherein both the sources and the owning sensor are local to the user.

20. A distributed blind source separation system comprising:

a plurality of sensors (120) in communication over a first network (150), each of the plurality of sensors configured to:

determine a set of active sensors of the plurality, each of the active sensors observing signals at a location of the plurality of sensors;

acquire signal information from the set of active sensors, the signal information including estimated source signals and sensor signals from each of the active sensors;

use the signal information to estimate a source signal generated by a source at the location,

transmit a communication indicating the estimated source signal and a sensor signal to one or more other sensors of the plurality, the sensor signal being particular to the transmitting sensor, and

broadcast the estimated source signal over a second network (155) to a user.

21. The distributed blind source separation system of claim 20, wherein each of the plurality of sensors includes:

a sensor observation transmission unit (325) configured to transmit a communication indicating an estimated source signal and a sensor signal to the one or more other sensors of the plurality;

a neighborhood communication acquisition unit (330) configured to acquire transmitted communications from other sensors of the plurality; and

a sensor observation acquisition unit (320) configured to acquire signal information at the location of the plurality of sensors.

22. A system of communicating sensors for extracting a plurality of source signals from a plurality of sensor observations, the system comprising:

a plurality of sensors having computational ability for processing, wherein

at least one sensor of the plurality is configured to compute sensor-processed information using observation information and previous sensor-processed information, the previous sensor-processed information being communicated by at least one other sensor of the plurality,

at least one sensor of the plurality is configured to communicate at least one extracted source signal to a user node, and

the computed sensor-processed information for at least one sensor of the plurality includes separated source signal sets computed for sequentially overlapping signal segments of a plurality of signals communicated by the plurality of sensors.