

## CLAIMS

1. A system, comprising:
  - a data source;
  - 5 a wavefield engine comprising:
    - a function engine to:
      - map seismic data stored in the data source into a scattering potential using a dictionary composed of at least one of Green's functions for homogeneous reference media or Asymptote and Apex-Shifted Hyperbolic Radon Transform (AASHRT) functions; and
      - 10 map the seismic data independently for at least one of a temporal frequency and inline wavenumber;
    - a data engine to:
      - create a simulated linear array of seismic receivers; and
      - 15 reconstruct the wavefield based on synthetic seismic data associated with the simulated linear array and exploited properties of the scattering potential within an inversion scheme; and
    - a decomposition engine to decompose the wavefield into upward and downward propagating constituents based on the mapping and the reconstructed wavefield.
- 20 2. The system of claim 1, further comprising the data engine to apply a sparseness-promoting numerical solver to generate the synthetic seismic data while exploiting properties of the mapped seismic data.
- 25 3. The system of claim 1, wherein the data engine comprises:
  - an analysis engine to describe wave propagation between scattering points and available wavefield measurements locations; and
  - a synthesis engine to describe wave propagation between scattering points and desired spatial locations of reconstructed wavefields.

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4. The system of claim 1, wherein the seismic data comprises data recorded in a physical experiment characterized by an actuation of a plurality of seismic sources.
5. The system of claim 1, wherein the seismic data comprises measurements  
5 uniformly distributed in space.
6. The system of claim 1, wherein the seismic data comprises measurements non-uniformly distributed in space.
- 10 7. The system of claim 1, wherein the seismic data comprises measurements of physical properties related to the wavefield.
8. A non-transitory machine-readable medium storing instructions executable by a processing resource to:
- 15 increase a density of wavefield measurements by creating a simulated linear array of seismic receivers between two streamers of a marine seismic survey;
- reconstruct a wavefield at a location away from a seismic receiver of the marine seismic survey based on seismic data sampled from the seismic receiver, synthetic seismic data associated with the simulated linear array, a vector of model coefficients  
20 comprising a scattering potential, and at least one of a mapping matrix comprising a dictionary of Green's functions or an operator defined by a combination of a number of functions.
9. The medium of claim 8, wherein the scattering potential is an equivalent source  
25 distribution.
10. The medium of claim 8, wherein the instructions executable to reconstruct a wavefield comprise instructions executable to reconstruct synthetic measurements at locations inside an area covered by available wavefield measurements.

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11. The medium of claim 8, wherein the instructions executable to reconstruct a wavefield comprise instructions executable to reconstruct synthetic measurements at available wavefield measurements locations.
- 5 12. The medium of claim 8, wherein the instructions executable to reconstruct a wavefield comprise instructions executable to reconstruct synthetic measurements at locations outside an area covered by available wavefield measurements.
13. The medium of claim 8, including instructions executable to model a virtual  
10 cable including a virtual seismic receiver at the location away from the seismic receiver.
14. A method, comprising:  
mapping, by a machine, seismic data into a scattering potential,  
wherein the mapping uses a dictionary of Green's functions for  
15 homogeneous reference media and exploits properties of the scattering potential within an inversion scheme;  
creating, by the machine, a simulated linear array of seismic receivers that increases a density of wavefield measurements associated with the seismic data;  
reconstructing, by the machine, a wavefield based on synthetic seismic data  
20 associated with the simulated array; and  
decomposing, by the machine, the wavefield into upward and downward propagating constituents based on the mapping and the reconstructed wavefield.
15. The method of claim 14, wherein the homogeneous reference media is bounded.  
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16. The method of claim 14, wherein the homogeneous reference media is unbounded.

17. The method of claim 14, wherein the inversion scheme is at least one of a sparseness-promoting numerical inversion scheme, a least squares scheme, and a weighted least squares scheme.
- 5 18. The method of claim 17, comprising mapping between available wavefield measurements and the scattering potential, the inversion scheme, and the reconstruction of the wavefield independently for each individual value of a temporal frequency.
- 10 19. The method of claim 17, comprising mapping between available wavefield measurements and the scattering potential, the sparseness-promoting numerical inversion scheme, and the reconstruction of wavefield independently for each individual value of an inline wavenumber.
- 15 20. The method of claim 14, wherein the dictionary is approximated by an Asymptote and Apex-Shifted Hyperbolic Radon dictionary.
21. The method of claim 14, further comprising:  
generating a geophysical data product from at least one of the seismic data, the wavefield based on the mapping, and the upward and downward propagating  
20 constituents.
22. The method of claim 21, further comprising recording the geophysical data product on a non-transitory machine-readable medium suitable for importing onshore.
- 25 23. The method of claim 21, wherein processing the geophysical data comprises processing the geophysical data offshore or onshore.