CLAIMS

1. A method of modeling a geophysical system, comprising:

defining a geophysical model of an area of the earth;

defining a domain for the geophysical model including a physical domain and a parameter domain, wherein the parameter domain comprises frequency, offset, and source position and receiver position;

defining a sparse domain for the geophysical model, wherein the sparse domain has a sparse parameter domain that is a subset of the parameter domain, wherein a density of points in the sparse parameter domain declines with a distance between the source position and the receiver position;

determining a geophysical basis of the geophysical system;

computing a sparse model result based on the sparse domain and the geophysical basis; and

resolving a model result from the sparse model result by interpolation.

2. The method of claim 1, further comprising determining a reconstruction error of the model result by computing a comparison model result based on the domain, and comparing the model result to the comparison model result.

3. The method of claim 2, further comprising changing the sparse domain based on the reconstruction error.

4. The method of claim 3, wherein changing the sparse domain comprises changing one or more of a density, uniformity, and periodicity of the sparse domain.

5. The method of claim 1, further comprising obtaining a perturbation response of the geophysical system and defining a model error by comparing the model result to the perturbation response.

6. The method of claim 5, further comprising changing one or more of a density, uniformity, and periodicity of the sparse domain based on the model error.

7. The method of claim 6, wherein the geophysical basis includes electrical resistivity.

8. The method of claim 1, wherein the domain has a first dimensionality, the interpolation has a second dimensionality, and the first dimensionality is equal to the second dimensionality.

9. The method of claim 1, further comprising performing a geophysical inversion process using the model result to form a data set representing physical properties of the area of the earth; and using the data set to predict the location of resource deposits in the area of the earth.

10. A method of determining physical properties of an area of the earth, comprising:

obtaining a geophysical survey of an area of the earth;

defining a geophysical model of the area of the earth;

defining a domain of the geophysical model including a physical domain and a parameter domain, wherein the parameter domain comprises frequency, offset, and source position and receiver position;

defining a sparse domain including the physical domain and a sparse parameter domain that is a subset of the parameter domain, wherein a density of points in the sparse parameter domain declines with a distance between the source position and the receiver position defining a geophysical basis for the area of the earth;

computing a sparse model result based on the sparse domain using the geophysical model;

resolving a model result from the sparse model result by interpolation;

defining a model error by comparing the model result to the geophysical survey; and

changing the geophysical basis based on the model error.

11. The method of claim 10, further comprising:

determining a reconstruction error of the geophysical model by resolving a comparison model result of the area of the earth based on the domain, and comparing the model result to the comparison model result; and

changing the sparse domain based on the reconstruction error.

12. The method of claim 11, wherein changing the sparse domain comprises changing one of a density, a uniformity, and a periodicity of the sparse domain.

13. The method of claim 12, further comprising:

defining a convergence criterion based on the model error; and

repeating the computing the sparse model result, resolving the model result, and defining the model error until the convergence criterion reaches a threshold.

14. The method of claim 13, wherein determining the reconstruction error is performed each time the model result is completed.

15. The method of claim 13, further comprising resolving an indication of hydrocarbon deposits from the geophysical basis after the convergence criterion reaches the threshold.

16. The method of claim 10, wherein the geophysical basis includes electrical resistivity.

17. A method of modeling a geophysical system, comprising:

defining a geophysical model of an area of the earth;

defining a domain for the geophysical model including a physical domain and a parameter domain, wherein the parameter domain comprises frequency, offset, and source position and receiver position;

defining a sparse domain for the geophysical model, wherein the sparse domain has a sparse parameter domain that is a subset of the parameter domain, wherein a density of points in the sparse parameter domain varies with water depth as a function of the source position and the receiver position;

determining a geophysical basis of the geophysical system;

computing a sparse model result based on the sparse domain and the geophysical basis; and

resolving a model result from the sparse model result by interpolation.

18. A method of determining physical properties of an area of the earth, comprising:

obtaining a geophysical survey of an area of the earth;

defining a geophysical model of the area of the earth;

defining a domain of the geophysical model including a physical domain and a parameter domain, wherein the parameter domain comprises frequency, offset, and source position and receiver position;

defining a sparse domain including the physical domain and a sparse parameter domain that is a subset of the parameter domain, wherein a density of points in the sparse parameter domain varies with water depth as a function of the source position and the receiver position;

defining a geophysical basis for the area of the earth;

computing a sparse model result based on the sparse domain using the geophysical model;

resolving a model result from the sparse model result by interpolation;

defining a model error by comparing the model result to the geophysical survey; and

changing the geophysical basis based on the model error.