[CLAIMS]

1. A fluid state estimation system comprising:

a learning device structured to learn an estimation model for estimating a state of a fluid inside of one of a plurality of components that are connected so that the fluid can enter and exit one another in a plant; and

an estimation device structured to estimate a state of a fluid inside of the component using the estimation model learned by the learning device, wherein

the estimation model is a surrogate model that substitutes a computational fluid dynamics simulator that simulates a two-dimensional distribution or a three-dimensional distribution of values of one or more physical quantities of a fluid inside the component using computational fluid dynamics;

the estimation model gets a value of an input variable, and outputs a two-dimensional distribution or three-dimensional distribution of values of the one or more physical quantities as a fluid state information representing a state of a fluid inside of the component,

the learning device includes

a learning data acquirer that acquires a set of the value of the input variable and the value of the fluid state information as learning data,

a computational fluid dynamics simulator that simulates a two-dimensional distribution or a three-dimensional

distribution of values of the one or more physical quantities of a fluid inside the component using computational fluid dynamics, and

a learner that learns the estimation model on the basis of the learning data,

the learning data acquirer acquires, as learning data, fluid state information calculated by simulating, by the computational fluid dynamics simulator, a two-dimensional distribution or a three-dimensional distribution of values of the one or more physical quantities of a fluid inside the component when the input variable is a specific value, and

the estimation device includes

a fluid state estimator that inputs a specific value of the input variable to the estimation model to estimate a two-dimensional distribution or a three-dimensional distribution of values of one or more physical quantities of a fluid inside of the component when the input variable is the specific value.

2. The fluid state estimation system according to claim 1, wherein

the estimation model estimates a steady state of a fluid inside of the component, and

the fluid state estimator inputs a specific value of the input variable to the estimation model to estimate a steady state of a fluid inside of the component when the

input variable is the specific value.

3. The fluid state estimation system according to claim 1 or 2, wherein

the learner includes

a fluid state information generator that generates a value of the fluid state information from input data,

an identifier that identifies the value of the fluid state information generated by the fluid state information generator and a value of fluid state information acquired by the learning data acquirer, and

an adversarial learner that learns the fluid state information generator and the identifier on the basis of an identification result by the identifier.

4. The fluid state estimation system according to any one of claims 1 to 3, wherein

the learning data acquirer acquires a set of a value of a range capable of being taken by the input variable during operation of the plant and a value of the fluid state information as learning data.

5. The fluid state estimation system according to any one of claims 1 to 4, wherein

the learning device includes a data assimilator that assimilates a calculated value of the fluid state information

calculated by the computational fluid dynamics simulator and an actual measurement value of the fluid state information actually measured when the plant is operated, and

the learning data acquirer acquires fluid state information assimilated by the data assimilator as the learning data.

6. The fluid state estimation system according to any one of claims 1 to 5, wherein

the fluid state estimator assimilates a calculated value of the fluid state information calculated by the estimation model and an actual measurement value of the fluid state information actually measured when the plant is operated.

7. The fluid state estimation system according to any one of claims 1 to 6, wherein

the estimation device further includes a fluid state display that displays the state of the fluid in the plant estimated by the fluid state estimator.

8. The fluid state estimation system according to any one of claims 1 to 7, wherein

the estimation device further includes an evaluator that evaluates a quality of a specific value of the input variable on the basis of the state of the fluid estimated by

the fluid state estimator inside of the component.

9. The fluid state estimation system according to any one of claims 1 to 8, wherein

the input variable includes at least a control amount used for control of the components.

10. A learning device comprising:

a learning data acquirer structured to acquire a set of a value of an input variable capable of affecting a state of a fluid inside one of a plurality of components that are connected so that the fluid can enter and exit one another in a plant and a value of a fluid state information representing a two-dimensional distribution or a three-dimensional distribution of values of one or more physical quantities of a fluid inside the component as learning data,

a computational fluid dynamics simulator structured to simulate a two-dimensional distribution or a three-dimensional distribution of values of the one or more physical quantities of a fluid inside the component using computational fluid dynamics, and

a learner structured to learn, as an estimation model for estimating a state of a fluid inside of the component, a surrogate model that substitutes a computational fluid dynamics simulator that simulates a two-dimensional distribution or a three-dimensional distribution of values of

the one or more physical quantities of a fluid inside the component using computational fluid dynamics on the basis of the learning data, wherein

the learning data acquirer acquires, as the learning data, fluid state information calculated by simulating, by the computational fluid dynamics simulator, a two-dimensional distribution or a three-dimensional distribution of values of the one or more physical quantities of a fluid inside the component when the input variable is a specific value.

11. The learning device according to claim 10, wherein

the learning device includes a data assimilator that assimilates a calculated value of the fluid state information calculated by the computational fluid dynamics simulator and an actual measurement value of the fluid state information actually measured when the plant is operated, and

the learning data acquirer acquires fluid state information assimilated by the data assimilator as the learning data.

12. A non-transitory computer-readable storage medium storing a learning program for causing a computer to function as:

a learning data acquirer that acquires a set of a value of an input variable capable of affecting a state of a fluid inside one of a plurality of components that are connected so

that the fluid can enter and exit one another in a plant and a value of a fluid state information representing a two-dimensional distribution or a three-dimensional distribution of values of one or more physical quantities of a fluid inside the component as learning data,

a computational fluid dynamics simulator that simulates a two-dimensional distribution or a three-dimensional distribution of values of the one or more physical quantities of a fluid inside the component using computational fluid dynamics, and

a learner that learns, as an estimation model to estimate a state of a fluid inside of the component, a surrogate model that substitutes a computational fluid dynamics simulator that simulates a two-dimensional distribution or a three-dimensional distribution of values of the one or more physical quantities of a fluid inside the component using computational fluid dynamics on the basis of the learning data, wherein

the learning data acquirer acquires, as the learning data, fluid state information calculated by simulating, by the computational fluid dynamics simulator, a two-dimensional distribution or a three-dimensional distribution of values of the one or more physical quantities of a fluid inside the component when the input variable is a specific value.

13. An estimation device comprising:

a fluid state estimator structured to input a specific value of an input variable to an estimation model to estimate a state of a fluid inside of one of a plurality of components that are connected so that the fluid can enter and exit one another in a plant when the input variable is the specific value, the estimation model being learned using, as learning data, a set of a value of the input variable capable of affecting a state of a fluid inside of the component and a value of a fluid state information representing a two-dimensional distribution or a three-dimensional distribution of values of one or more physical quantities of a fluid inside the component, the estimation model getting the value of the input variable and outputting the value of the fluid state information, wherein

the estimation model is learned using, as learning data, fluid state information calculated by simulating, by the computational fluid dynamics simulator that simulates a two-dimensional distribution or a three-dimensional distribution of values of the one or more physical quantities of a fluid inside the component using computational fluid dynamics, a two-dimensional distribution or a three-dimensional distribution of values of the one or more physical quantities of a fluid inside the component when the input variable is a specific value.

14. The estimation device according to Claim 13,

wherein

the fluid state estimator assimilates a calculated value of the fluid state information calculated by the estimation model and an actual measurement value of the fluid state information actually measured when the plant is operated.

15. A non-transitory computer-readable storage medium storing an estimation program for causing a computer to function as:

a fluid state estimator structured to input a specific value of an input variable to an estimation model to estimate a state of a fluid inside of one of a plurality of components that are connected so that the fluid can enter and exit one another in a plant when the input variable is the specific value, the estimation model being learned using, as learning data, a set of a value of the input variable capable of affecting a state of a fluid inside of the component and a value of a fluid state information representing a two-dimensional distribution or a three-dimensional distribution of values of one or more physical quantities of a fluid inside the component, the estimation model getting the value of the input variable and outputting the value of the fluid state information, wherein

the estimation model is learned using, as learning data, fluid state information calculated by simulating, by

the computational fluid dynamics simulator that simulates a two-dimensional distribution or a three-dimensional distribution of values of the one or more physical quantities of a fluid inside the component using computational fluid dynamics, a two-dimensional distribution or a three-dimensional distribution of values of the one or more physical quantities of a fluid inside the component when the input variable is a specific value.