

CLAIMS

[Claim 1]

A cooperative learning system for use in process monitoring in which a monitoring model is provided for each of a plurality of processes arranged in chronological order at predetermined transmission time intervals, comprising:

a storage section storing, in chronological order, first monitoring data in a first process, second monitoring data in a second process upstream or downstream of the first process, and at least one monitoring result from the first process output from a first monitoring model using the first monitoring data as an input parameter; and

a model learning section configured to perform parent model learning processing for the first monitoring model by using the first monitoring data and the monitoring result from the first monitoring model and to perform child model learning processing for a second monitoring model by using a monitoring result from the first monitoring model at a first time as teacher data and using the second monitoring data at a second time as an input parameter, the second time being shifted from the first time by a transition period,

~~[Claim 2]~~

~~The cooperative learning system according to claim 1, wherein the model learning section is configured to perform the child model learning processing for the second monitoring model by using the monitoring result from the first monitoring model at the first time obtained as teacher data and using, as input parameters, the second~~

monitoring data obtained in the second process at the second time ~~shifted from the first time by the transition period~~ and the first monitoring data obtained in the first process at a same time as ~~at the~~ second time.

[~~Claim-3~~ 2]

The cooperative learning system according to claim 1 ~~or 2~~, wherein third monitoring data in a third process upstream or downstream of the second process, and at least one monitoring result from the second process output from the second monitoring model constructed through the child model learning processing using the second monitoring data as an input parameter are stored in chronological order, and

the model learning section is configured to perform the child model learning processing for a third monitoring model by using a monitoring result from the second monitoring model at a third time as teacher data and using the third monitoring data at a fourth time as an input parameter, the fourth time being shifted from the third time by a transition period.

[~~Claim-4~~ 3]

The cooperative learning system according to claim 1 ~~or 2~~, wherein third monitoring data in a third process upstream or downstream of the second process is stored in chronological order,

the model learning section is configured to perform the child model learning processing for a third monitoring model by using a monitoring result from the first monitoring model at the first time as teacher data and using the third monitoring data at a fifth time

as an input parameter, the fifth time being shifted from the first time by a transition period.

[Claim~~5~~4]

The cooperative learning system according to any one of claims 1 to~~4~~3, wherein the first process is a process acting as a bottleneck in all of the plurality of processes arranged in chronological order at predetermined transition time period intervals.

[Claim~~6~~5]

A monitoring system for performing process monitoring in a plurality of processes arranged in chronological order at predetermined transmission time intervals, comprising:

a data collection control apparatus configured to collect monitoring data output from each of the plurality of processes;

a monitoring control apparatus configured to use a monitoring model set for each of the plurality of processes to output at least one monitoring result based on the monitoring data for each process; and

a cooperative learning apparatus configured to control learning of the monitoring model for each process,

wherein the cooperative learning apparatus is configured to:
_____store, in chronological order, first monitoring data in a first process, second monitoring data in a second process upstream or downstream of the first process, and at least one monitoring result from the first process output from a first monitoring model using the first monitoring data as an input parameter, and

_____perform parent model learning processing for the first monitoring model by using the first monitoring data and the monitoring result from the first monitoring model and perform child model learning processing for a second monitoring model by using a monitoring result from the first monitoring model at a first time as teacher data and using the second monitoring data at a second time as an input parameter, the second time being shifted from the first time by a transition period, -

wherein the model learning section is configured to perform the child model learning processing for the second monitoring model by using the monitoring result from the first monitoring model at the first time obtained as teacher data and using, as input parameters, the second monitoring data obtained in the second process at the second time and the first monitoring data obtained in the first process at a same time as the second time.

[Claim-7_6]

The monitoring system according to claim-6_5, wherein the first process is a process acting as a bottleneck in all of the plurality of processes arranged in chronological order at predetermined transition time period intervals, and

the plurality of processes comprise water treatment processes.

[Claim-8_7]

A program configured to be executed by a computer for performing cooperative learning processing in process monitoring in which a monitoring model is provided for each of a plurality of processes

arranged in chronological order at predetermined transmission time intervals, the program comprising instructions which, when executed by a computer, cause the computer to perform:

a first function of storing, in chronological order, first monitoring data in a first process, second monitoring data in a second process upstream or downstream of the first process, and at least one monitoring result from the first process output from a first monitoring model using the first monitoring data as an input parameter; and

a second function of performing parent model learning processing for the first monitoring model by using the first monitoring data and the monitoring result from the first monitoring model and performing child model learning processing for a second monitoring model by using a monitoring result from the first monitoring model at a first time as teacher data and using the second monitoring data at a second time as an input parameter, the second time being shifted from the first time by a transition period,

wherein the performing of the child model learning processing for the second monitoring model is performed by using the monitoring result from the first monitoring model at the first time obtained as teacher data and using, as input parameters, the second monitoring data obtained in the second process at the second time and the first monitoring data obtained in the first process at a same time as the second time.

[Claim~~9~~8]

A program configured to be executed by a computer for performing process monitoring in a plurality of processes arranged in chronological order at predetermined transmission time intervals, the program comprising instructions which, when executed by a computer, cause the computer to perform:

a first function of collecting monitoring data output from each of the plurality of processes;

a second function of using a monitoring model set for each of the plurality of processes to output at least one monitoring result based on the monitoring data for each process; and

a third function of controlling learning of the monitoring model for each process,

wherein the third function includes:

_____storing, in chronological order, first monitoring data in a first process, second monitoring data in a second process upstream or downstream of the first process, and at least one monitoring result from the first process output from a first monitoring model using the first monitoring data as an input parameter; and

_____performing parent model learning processing for the first monitoring model by using the first monitoring data and the monitoring result from the first monitoring model and performing child model learning processing for a second monitoring model by using a monitoring result from the first monitoring model at a first time as teacher data and using the second monitoring data at a second time as an input parameter, the second time being shifted from the first time by a transition period,,-

wherein the performing of the child model learning processing for the second monitoring model is performed by using the monitoring result from the first monitoring model at the first time obtained as teacher data and using, as input parameters, the second monitoring data obtained in the second process at the second time and the first monitoring data obtained in the first process at a same time as the second time.