

## CLAIMS

What is claimed is:

- 5 1. A method of detecting anomaly in a physical process associated with a networked control system using at least one processor, the method comprising:
- obtaining, for each process run of a plurality of process runs for a state process at a process state of the physical process, measured sensor data associated with the process run in relation to a physical state associated with the state process at the process state;
- 10 producing, for said each process run of the plurality of process runs, process offset data associated with the process run based on the measured sensor data associated with the process run and modelled sensor data in relation to the physical state associated with the state process, to obtain a plurality of process offset data associated with the plurality of process runs, respectively, in relation to the physical state associated with the state process;
- 15 determining process skew fingerprint information associated with the plurality of process runs based on the plurality of process offset data, the process skew fingerprint information comprising characteristic information associated with the plurality of process offset data; and
- detecting anomaly in the physical process based on the process skew fingerprint
- 20 information associated with the plurality of process runs for the state process at the process state of the physical process.
2. The method according to claim 1, further comprising determining the modelled sensor data in relation to the physical state associated with the state process, comprising estimating
- 25 sensor data in relation to the physical state associated with the state process based on a system model representing the state process and one or more design parameters associated with the state process.
3. The method according to claim 1 or 2, wherein said producing, for said each process
- 30 run of the plurality of process runs of the state process at the process state, process offset data associated with the process run comprises:
- determining, for each time step of a plurality of time steps, a process offset between the measured sensor data associated with the process run obtained at the time step and the modelled

sensor data at the time step in relation to the physical state associated with the state process, to obtain a plurality of process offset information associated with the process run at the plurality of time steps, respectively, wherein the process offset data associated with the process run comprises the plurality of process offset information associated with the process run.

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4. The method according to claim 3, wherein said determining, for said each time step of the plurality of time steps, the process offset comprises determining, for said each time step of the plurality of time steps, a difference between the measured sensor data associated with the process run obtained at the time step and the modelled sensor data at the time step in relation to the physical state associated with the state process, to obtain the plurality of process offset information associated with the process run at the plurality of time steps, respectively.

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5. The method according to any one of claims 1 to 4, wherein said determining the process skew fingerprint information associated with the plurality of process runs comprises determining a slope parameter associated with the plurality of process offset data associated with the plurality of process runs in relation to the physical state associated with the state process, wherein the process skew fingerprint information comprises the slope parameter.

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6. The method according to claim 5, wherein said determining the slope parameter associated with the plurality of process offset data comprising applying a linear regression model to the plurality of process offset data to obtain a regression coefficient, wherein the slope parameter comprises the regression coefficient.

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7. The method according to any one of claims 1 to 6, wherein said detecting anomaly in the physical process comprises detecting anomaly in the physical process based on the process skew fingerprint information associated with the plurality of process runs for the state process at the process state of the physical process and a reference process skew fingerprint information associated with the state process at the process state of the physical process.

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8. The method according to claim 7, further comprising determining the reference process skew fingerprint information associated with the state process at the process state of the physical process, comprising:

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obtaining, for each reference process run of a plurality of reference process runs for the state process at the process state of the physical process, measured sensor data associated with the reference process run in relation to the physical state associated with the state process at the process state;

5       producing, for said each reference process run of the plurality of reference process runs, reference process offset data associated with the reference process run based on the measured sensor data associated with the reference process run and the modelled sensor data in relation to the physical state associated with the state process, to obtain a plurality of reference process offset data associated with the plurality of reference process runs, respectively, in relation to  
10       the physical state associated with the state process; and

          determining the reference process skew fingerprint information associated with the plurality of reference process runs based on the plurality of reference process offset data, the reference process skew fingerprint information comprising characteristic information associated with the plurality of reference process offset data.

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9.       The method according to any one of claims 1 to 8, wherein said detecting anomaly in the physical process comprises detecting an attack on the networked control system based on the process skew fingerprint information associated with the plurality of process runs for the state process at the process state of the physical process.

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10.      A system for detecting anomaly in a physical process associated with a networked control system, the system comprising:

          a memory; and

          at least one processor communicatively coupled to the memory and configured to:

25               obtain, for each process run of a plurality of process runs for a state process at a process state of the physical process, measured sensor data associated with the process run in relation to a physical state associated with the state process at the process state;

              produce, for said each process run of the plurality of process runs, process offset data associated with the process run based on the measured sensor data associated with the  
30       process run and modelled sensor data in relation to the physical state associated with the state process, to obtain a plurality of process offset data associated with the plurality of process runs, respectively, in relation to the physical state associated with the state process;

determine process skew fingerprint information associated with the plurality of process runs based on the plurality of process offset data, the process skew fingerprint information comprising characteristic information associated with the plurality of process offset data; and

- 5 detect anomaly in the physical process based on the process skew fingerprint information associated with the plurality of process runs for the state process at the process state of the physical process.

11. The system according to claim 10, wherein the at least one processor is further  
10 configured to determine the modelled sensor data in relation to the physical state associated with the state process, comprising estimating sensor data in relation to the physical state associated with the state process based on a system model representing the state process and one or more design parameters associated with the state process.

12. The system according to claim 10 or 11, wherein said produce, for said each process run of the plurality of process runs of the state process at the process state, process offset data associated with the process run comprises:

- determining, for each time step of a plurality of time steps, a process offset between the measured sensor data associated with the process run obtained at the time step and the modelled  
20 sensor data at the time step in relation to the physical state associated with the state process, to obtain a plurality of process offset information associated with the process run at the plurality of time steps, respectively, wherein the process offset data associated with the process run comprises the plurality of process offset information associated with the process run.

13. The system according to claim 12, wherein said determining, for said each time step of the plurality of time steps, the process offset comprises determining, for said each time step of the plurality of time steps, a difference between the measured sensor data associated with the process run obtained at the time step and the modelled sensor data at the time step in relation to the physical state associated with the state process, to obtain the plurality of process offset  
30 information associated with the process run at the plurality of time steps, respectively.

14. The system according to any one of claims 10 to 13, wherein said determine the process skew fingerprint information associated with the plurality of process runs comprises

determining a slope parameter associated with the plurality of process offset data associated with the plurality of process runs in relation to the physical state associated with the state process, wherein the process skew fingerprint information comprises the slope parameter.

5 15. The system according to claim 14, wherein said determining the slope parameter associated with the plurality of process offset data comprising applying a linear regression model to the plurality of process offset data to obtain a regression coefficient, wherein the slope parameter comprises the regression coefficient.

10 16. The system according to any one of claims 10 to 15, wherein said detect anomaly in the physical process comprises detecting anomaly in the physical process based on the process skew fingerprint information associated with the plurality of process runs for the state process at the process state of the physical process and a reference process skew fingerprint information associated with the state process at the process state of the physical process.

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17. The system according to claim 16, wherein the at least one processor is further configured to determine the reference process skew fingerprint information associated with the state process at the process state of the physical process, comprising:

20 obtaining, for each reference process run of a plurality of reference process runs for the state process at the process state of the physical process, measured sensor data associated with the reference process run in relation to the physical state associated with the state process at the process state;

25 producing, for said each reference process run of the plurality of reference process runs, reference process offset data associated with the reference process run based on the measured sensor data associated with the reference process run and the modelled sensor data in relation to the physical state associated with the state process, to obtain a plurality of reference process offset data associated with the plurality of reference process runs, respectively, in relation to the physical state associated with the state process; and

30 determining the reference process skew fingerprint information associated with the plurality of reference process runs based on the plurality of reference process offset data, the reference process skew fingerprint information comprising characteristic information associated with the plurality of reference process offset data.

18. The system according to any one of claims 10 to 17, wherein said detect anomaly in the physical process comprises detecting an attack on the networked control system based on the process skew fingerprint information associated with the plurality of process runs for the state process at the process state of the physical process.

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19. A computer program product, embodied in one or more non-transitory computer-readable storage mediums, comprising instructions executable by at least one processor to perform the method of detecting anomaly in a physical process associated with a networked control system according to any one of claims 1 to 9.

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