

CLAIMS

What is claimed is:

- 5 1. A method of controlling an air-conditioning system associated with a building for optimizing a plurality of building performance parameters in providing an environment with respect to a zone of the building, using at least one processor, the method comprising:
- obtaining zone environmental condition information including zone temperature data associated to the zone, and cooling air temperature data associated to an air handling
10 unit associated to the zone;
- obtaining, from a zone model generator, zone cooling load parameters associated to the zone with respect to a plurality of time periods and a zone thermal dynamic model;
- obtaining, from a scheduler, a sequence of optimal cool air supply rates with respect to a plurality of subsequent time periods with respect to the zone determined based on a
15 multi-component cost function including a plurality of components relating to the plurality of building performance parameters;
- determining, based on the zone thermal dynamic model, a sequence of zone controller set-points corresponding to the sequence of optimal cool air supply rates with respect to the zone using the zone cooling load parameters, the sequence of optimal cool
20 air supply rates, the zone temperature data and the cooling air temperature data associated to the air handling unit; and
- sending the sequence of zone controller set-points to a zone controller for controlling a temperature of the zone.
- 25 2. The method according to claim 1, wherein said obtaining zone environmental condition information including zone temperature data associated to the zone comprises obtaining, from the zone model generator, zone temperature data associated to the zone with respect to the plurality of subsequent time periods.
- 30 3. The method according to claim 2, wherein said obtaining zone environmental condition information including zone temperature data associated to the zone comprises

obtaining, from a zone sensor module, zone temperature measurement data associated to the zone with respect to a current time.

4. The method according to any one of claims 1 to 3, wherein said obtaining cooling
5 air temperature data associated to an air handling unit associated to the zone comprises obtaining the cooling air temperature measurement data associated to the air handling unit associated to the zone with respect to a current time.
5. The method according to claims 1 to 4, wherein the zone thermal dynamic model
10 is trained by the model generator based on measured data of zone temperature associated to the zone, zone cool air supply rate associated to the zone and cooling air temperature associated to the air handling unit associated to the zone.
6. The method according to any one of claims 1 to 5, wherein the plurality of
15 components of the multi-component cost function comprise a first component relating to zone occupancy associated to the zone determined based on a zone occupancy detection model, a second component relating to fan power of the air handling unit determined based on a fan power function, a third component relating to chiller power determined based on a chiller power function, a fourth component relating to coupling of a pressure of the supply
20 fan associated to the air handling unit and zone air flow rates corresponding to zones associated to the air handling unit determined based on a coupling function in relation to the pressure of the supply fan associated to the air handling unit and the zone air flow rates corresponding to zones associated to the air handling unit.
- 25 7. The method according to any one of claims 1 to 6, wherein the plurality of components of the multi-component cost function further comprise a component relating to respective zone cool air supply rate requests corresponding to the zone and one or more other zones in the building with respect to the plurality of subsequent time periods.

8. The method according to any one of claims 1 to 7, wherein the plurality of components of the multi-component cost function further comprise a component relating to occupant thermal comfort.
- 5 9. The method according to claim 8, wherein the component relating to occupant thermal comfort comprises a thermal set-point obtained from a predetermined value, predicted based on an occupant thermal comfort prediction model or obtained from user input.
- 10 10. The method according to claim 9, further comprising predicting, based on the occupant thermal comfort prediction model, the occupant thermal comfort using the zone temperature data, zone humidity data, zone carbon dioxide concentration data and zone cool air supply rate data associated to the zone obtained from a zone sensor module.
- 15 11. The method according to any one of claims 1 to 10, wherein the zone controller comprises a zone variable air volume controller.
12. A control system for controlling an air-conditioning system associated with a building for optimizing a plurality of building performance parameters in providing an
20 environment with respect to a zone of the building, the control system comprising:
a memory; and
at least one processor communicatively coupled to the memory and configured to:
obtain zone environmental condition information including zone
temperature data associated to the zone, and cooling air temperature data associated
25 to an air handling unit associated to the zone;
obtain, from a zone model generator, zone cooling load parameters
associated to the zone with respect to a plurality of time periods and a zone thermal
dynamic model;
obtain, from a scheduler, a sequence of optimal cool air supply rates with
30 respect to the plurality of subsequent time periods with respect to the zone

determined based on a multi-component cost function including a plurality of components relating to the plurality of building performance parameters;

determine, based on the zone thermal dynamic model, a sequence of zone controller set-points corresponding to sequence of optimal cool air supply rates with respect to the zone using the zone cooling load parameters, the sequence of optimal cool air supply rates, the zone temperature data and the cooling air temperature data associated to the air handling unit; and

send the sequence of zone controller set-points to a zone controller for controlling a temperature of the zone.

13. The system according to claim 12, wherein said obtain zone environmental condition information including zone temperature data associated to the zone comprises obtain, from the zone model generator, zone temperature data associated to the zone with respect to the plurality of subsequent time periods.

14. The system according to claim 12 or 13, wherein said obtain zone environmental condition information including zone temperature data associated to the zone comprises obtain, from a zone sensor module, zone temperature measurement data associated to the zone with respect to a current time.

15. The system according to claims 12 to 14, wherein the zone thermal dynamic model is trained by the model generator based on measured data of zone temperature associated to the zone, zone cool air supply rate associated to the zone and the cool air temperature associated to the air handling unit associated to the zone.

16. The system according to any one of claims 12 to 15, wherein the plurality of components of the multi-component cost function comprise a first component relating to zone occupancy associated to the zone determined based on a zone occupancy detection model, a second component relating to fan power of the air handling determined based on a fan power function, a third component relating to chiller power determined based on a chiller power function, a fourth component relating to coupling of a pressure of the supply

fan associated to the air handling unit and zone air flow rates corresponding to zones associated to the air handling unit determined based on a coupling function in relation to the pressure of the supply fan associated to the air handling unit and the zone air flow rates corresponding to the zones associated to the air handling unit.

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17. The system according to any one of claims 12 to 16, wherein the plurality of components of the multi-component cost function further comprise a component relating to occupant thermal comfort.

10 18. The system according to claim 17, wherein the component relating to occupant thermal comfort comprises a thermal set-point obtained from a predetermined value, predicted based on an occupant thermal comfort prediction model or obtained from user input.

15 19. The system according to claim 18, further comprising predicting, based on the occupant thermal comfort prediction model, the occupant thermal comfort using the zone temperature data, zone humidity data, zone carbon dioxide concentration data and zone cool air supply rate data associated to the zone obtained from a zone sensor module.

20 20. The system according to any one of claims 12 to 19, wherein the zone controller comprises a variable air volume VAV controller.

21. A computer program product, embodied in one or more non-transitory computer-readable storage mediums, comprising instructions executable by at least one
25 processor to perform a method of controlling an air-conditioning system associated with a building for optimizing a plurality of building performance parameters in providing an environment with respect to a zone of the building according to any one of claims 1 to 11.