CLAIMS

1. A decentralized flow control system comprising a plurality of components for carrying out local flow control tasks, wherein each of the plurality of components comprises:

at least one mechanical element configured to adjust one or more flows;

at least one sensor configured to detect the one or more flows;

at least one actuator configured to mechanically adjust the at least one of the mechanical element;

a communication interface configured to communicate with at least one other component of the plurality of components; and

a component processor configured to calculate a local optimized flow plan based on data from the at least one sensor, communicate the local optimized flow plan to at least one other component of the plurality of components to negotiate an optimized system flow plan with the other components of the plurality of components, and implement the optimized system flow plan though the at least one actuator.

2. The decentralized flow control system of claim 1, wherein the flow control system is a building water system.

3. The decentralized flow control system of claim 2, wherein the mechanical element is a pump.

4. The decentralized flow control system of claim 1, further comprising:

a component memory configured to store initialization data comprising one or more values for operation of the flow control system.

5. The decentralized flow control system of claim 4, wherein the component processor calculates a local optimized flow using the initialization data.

6. The decentralized flow control system of claim 1, wherein the component processor negotiates the optimized system flow plan by performing a consensus function.

7. The decentralized flow control system of claim 6, wherein the consensus function comprises an alternating direction method of multipliers method.

8. The decentralized flow control system of claim 6, wherein the consensus function comprises an augmented Lagrangian method.

9. The decentralized flow control system of claim 1, wherein after a fault is detected, the component processor calculates a new optimized flow plan taking into consideration the fault.

10. A method for generating a flow control plan by a plurality of agents in a flow control system, the method comprises:

calculating, by an agent of the plurality of agents, values for one or more local parameters of components controlled by the agent;

negotiating, between the agent and connected agents of the plurality of agents, values for one or more shared parameters;

adjusting, by the agent, the values of one or more local parameters based on the negotiated values;

generating, by the agent, a local flow control plan using the adjusted values; and

implementing, by the agent, the local flow control plan.

11. The method of claim 10, wherein the local parameters comprise at least a flow rate and temperature.

12. The method of claim 10, wherein negotiating comprises determining consensus for the values of the one or more shared parameters using an augmented Lagrangian method.

13. The method of claim 10, wherein negotiating is repeated until a consensus between the plurality of agents is determined for the values of the one or more shared parameters.

14. The method of claim 10, further comprising:

detecting a fault of a component controlled by the agent;

calculating, by the agent, updated values for the one or more local parameters of components controlled by the agent as a function of the fault;

negotiating, between connected agents of the plurality of agents, updated values for one or more shared parameters;

adjusting the updated values of one or more local parameters based on the negotiated values;

generating a local flow control plan using the updated adjusted values; and

implementing the local flow control plan.

15. A device for controlling an intelligent water pump in a building control system, the device comprising:

a memory configured to store configuration data and optimization data;

a communications interface configured to communicate values for one or more shared parameters with one or more other devices; and

a processor configured to calculate values for local parameters and shared parameters based on the configuration data and optimization data; the processor configured to negotiate values for the shared parameters with the one or more other devices; the processor configured to recalculate values of local parameters as a function of the negotiated shared parameters; the processor configured to generate a flow control plan as a function of the recalculated values and the negotiated shared parameters.

16. The system of claim 15, wherein the processor is configured to negotiate values using a consensus function.

17. The system of claim 16, wherein the consensus function comprises an alternating direction method of multipliers function.

18. The system of claim 15, wherein the other devices comprise other intelligent water pumps in the building control system.

19. The system of claim 18, wherein the configuration data comprises static and dynamic settings.

20. The system of claim 19, wherein static settings comprise algorithm parameters and static values of an optimization problem and the dynamic settings comprise data as measured through one or more sensors connected to the intelligent water pump.