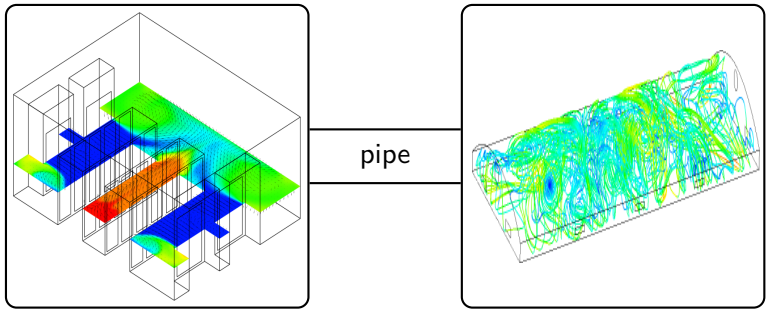
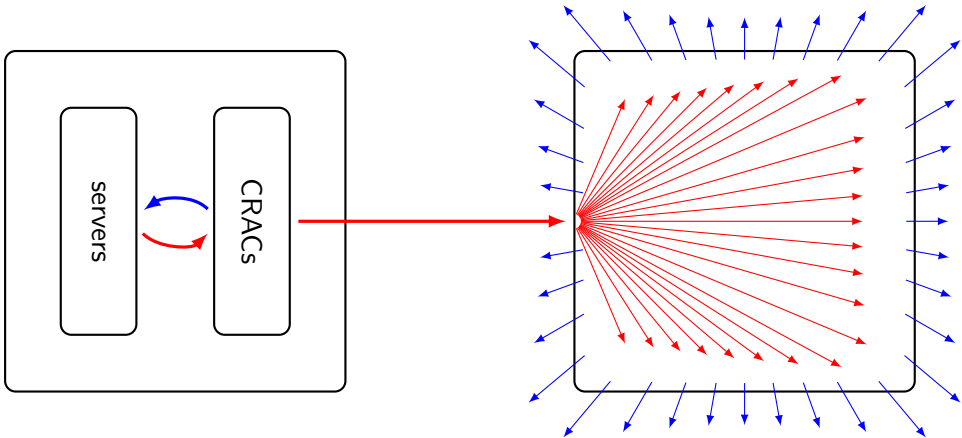
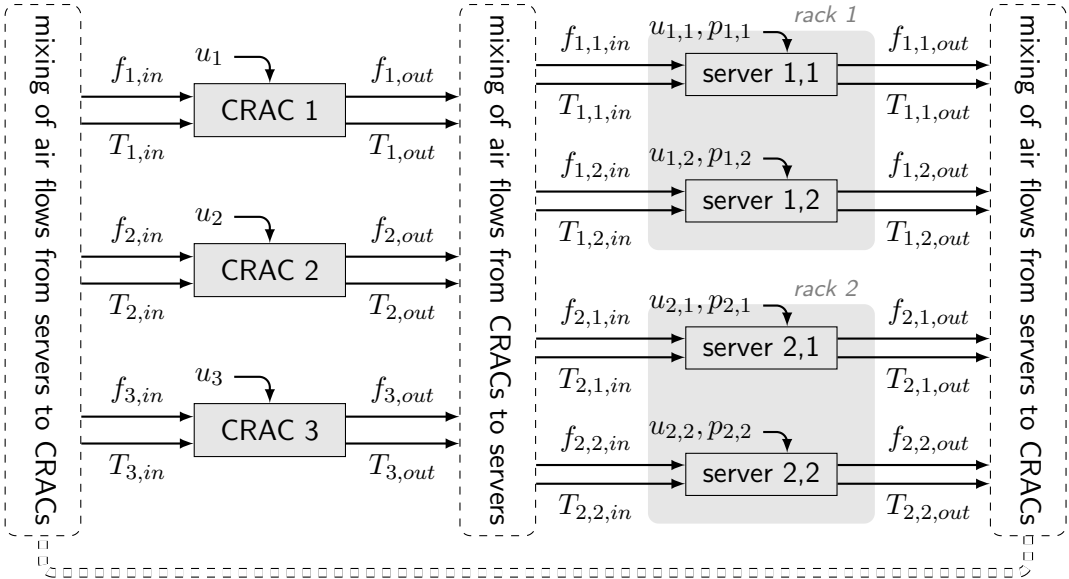
The system from CFD perspectives



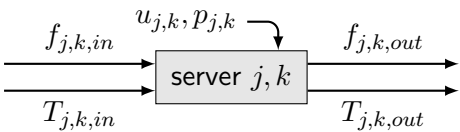
The system from control-oriented perspectives

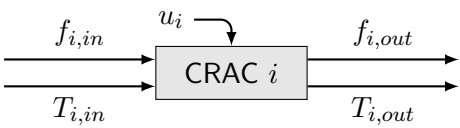


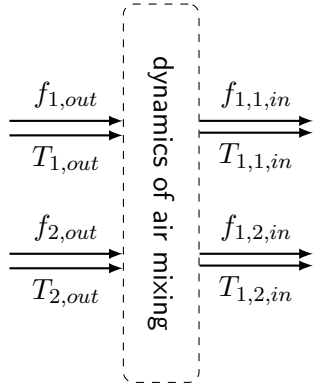
Control-oriented model of a computer room



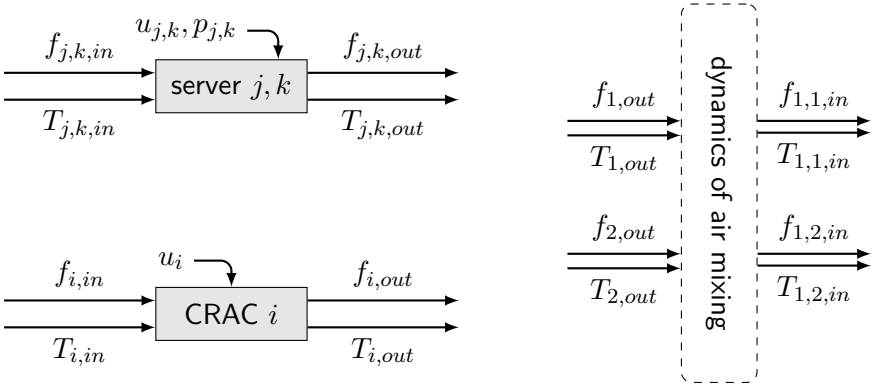
Ingredients for obtaining a control-oriented model





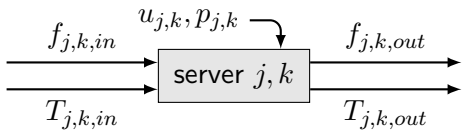


Ingredients for obtaining a control-oriented model



can be obtained combining measurements from CFD and real plant!

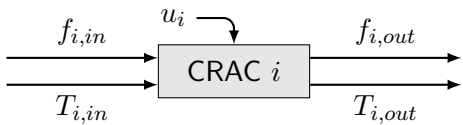
Control-oriented model of a server



$$f_{j,k,out}(t) = \alpha_f^s f_{j,k,in}(t) + u_{j,k}(t) \tag{1}$$

$$\dot{T}_{j,k,out}(t) = \underbrace{\alpha_T^s f_{j,k,in}(t)\Big(T_{j,k,in}(t) - T_{j,k,out}(t)\Big)}_{\text{convection}} + \underbrace{\alpha_p^s p_{j,k}(t)}_{\text{el. power}} \tag{2}$$

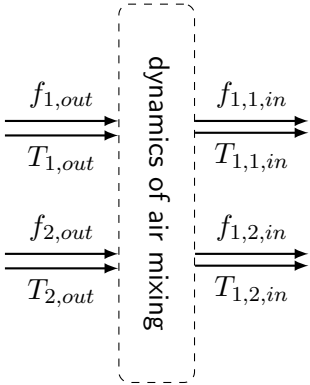
Control-oriented model of a CRAC



$$f_{i,out}(t) = \alpha_f^c f_{i,in}(t) + u_i(t) \tag{3}$$

$$\dot{T}_{i,out}(t) = \underbrace{\alpha_T^c f_{i,in}(t)\Big(T_{i,in}(t) - T_{i,out}(t)\Big)}_{\text{convection}} + \underbrace{\alpha_p^c p_i(t)}_{\text{el. power}} \tag{4}$$

Control-oriented model of the air dynamics



$$f_{j,k,in}(t) = \sum_i s_{i\to j,k} f_{i,out}(t - \Delta_{i\to j,k}) \quad (5)$$

$$T_{j,k,in}(t) = \frac{\sum_i s_{i\to j,k} T_{i,out}(t - \Delta_{i\to j,k})}{\sum_i s_{i\to j,k}} \quad (6)$$

The control problem – datacenter side

optimal operational plan $=$ minimize $\Big(\alpha \cdot$ operational costs $- \beta T_{\text{out}} - \gamma f_{\text{out}}\Big)$

while guaranteeing:

- operational constraints
- thermal comfort