Transactive Control of Smart Railway Grid

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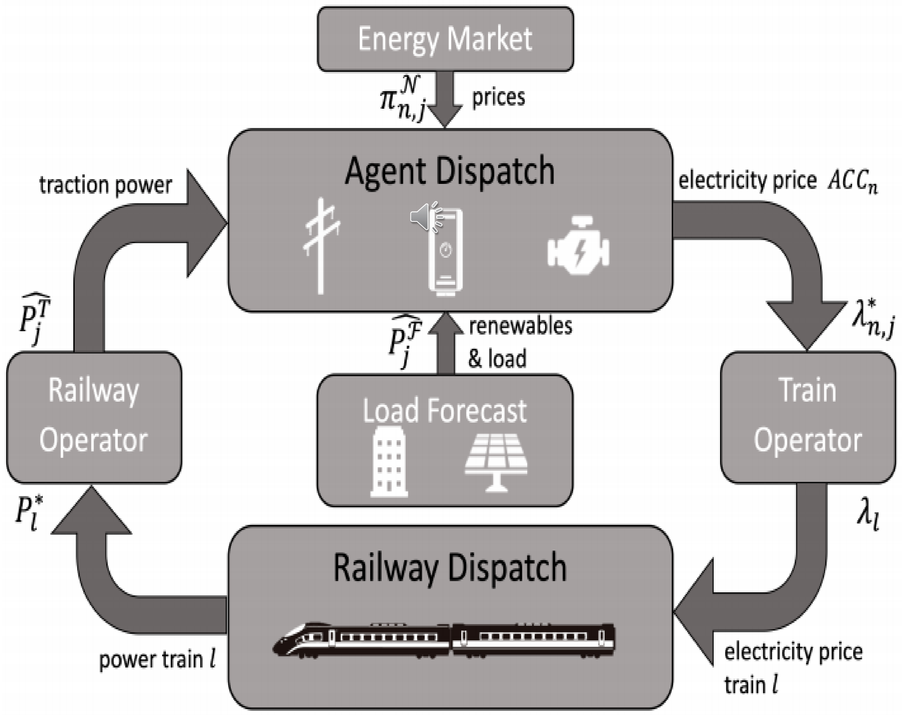
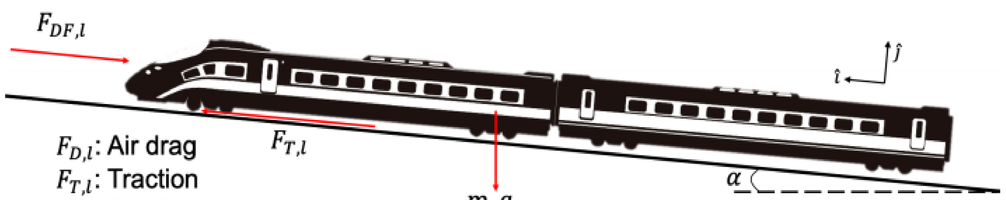
Challenge:

- Energy cost reduction of electric railway system
- Data-driven velocity adjustment of the train network
- Bi-directional communication between the train network and the electric grid system

Solution:

- Transactive control methodology
- Online price negotiation process
- Two step optimization process





$F_{D,l}$ and $F_{F,l}$ modeled together as $F_{DF,l} = A_l + B_l\dot{x}_l + C_l\dot{x}_l^2$ (*Davis Equation*)

A: rolling resistance; B: momentum losses; C: aerodynamic drag

$$m_l\ddot{x}_l = F_{T,l} - F_{DF,l} - m_l g\sin(\alpha_l(x_l))$$

$\alpha(x_{l,s}) = 0\ \forall\, s \in \{0, \dots, D\}$ (i.e. at the passenger stations)

Scientific Impact:

- Advanced mathematical modeling of the train dynamics
- Formulation of the transactive control methodology
- Optimization techniques like dynamic programming

Broader Impact:

- High-Speed electric railway system has application in emergency situations
- Results of the Simulation show potential reduction of energy cost up to 10%

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