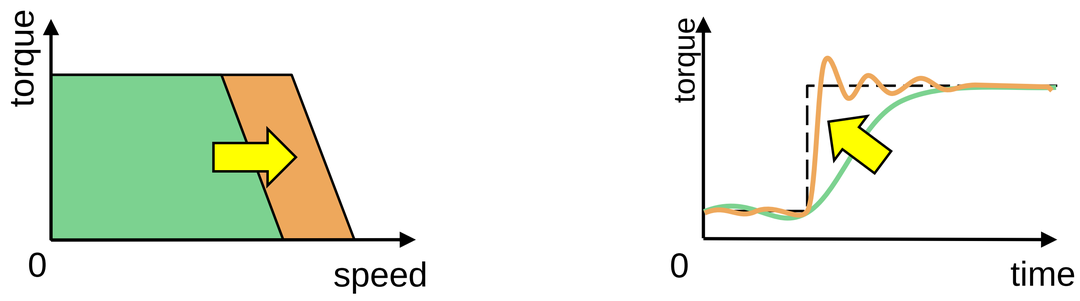
Implementations of Current Control System of PMSM based on Model Predictive Control

DoKi

◆Background

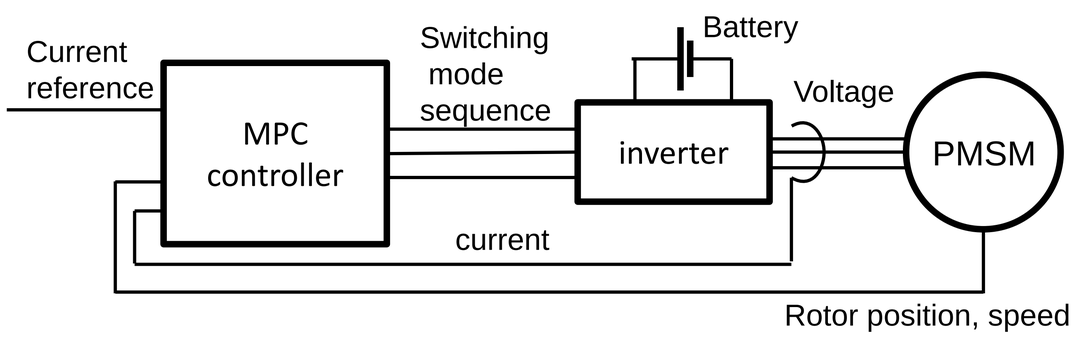
In motor control system of hybrid vehicle and electric car,
Wide range and high speed torque response is requested.



For incarnating these demands,
We conduct research application of
Model Predictive Control(MPC)
to current control system of PMSM

◆Model Predictive Control(MPC)

■Motor drive system based on MPC

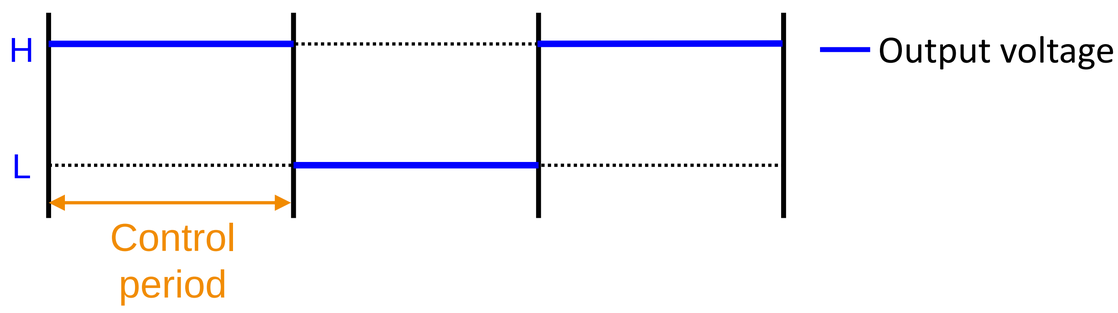


A momentary output voltage of inverter is limited 8 kinds
In Model Predictive Control,
Controller decide the output voltage vector sequences
which become most suitable current response by searching

■Proposed MPC

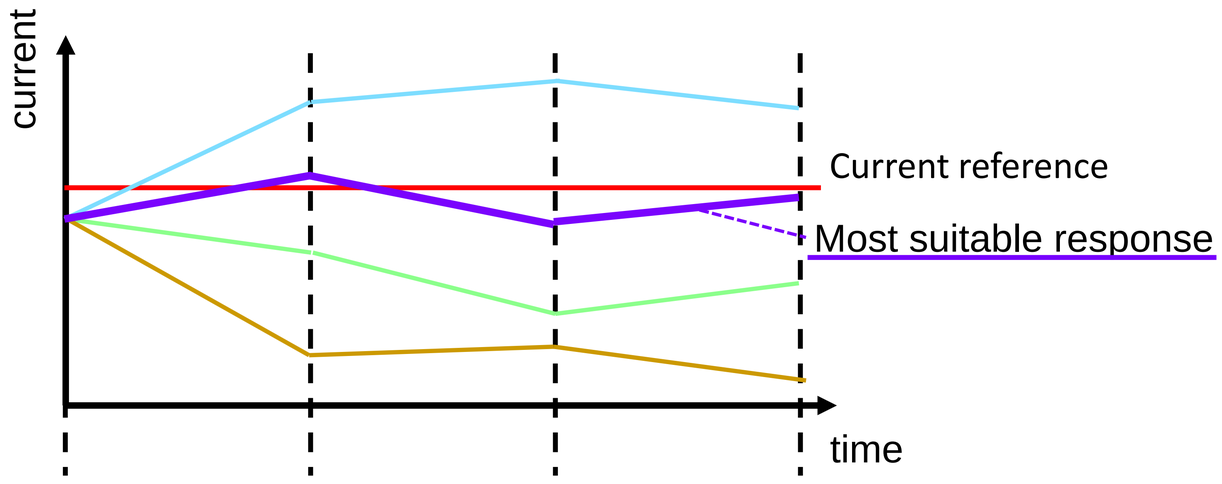
In previous MPC, phase resolution is lacking because minimum pulse width of output voltage vector sequences is the same of control period

- Previous MPC



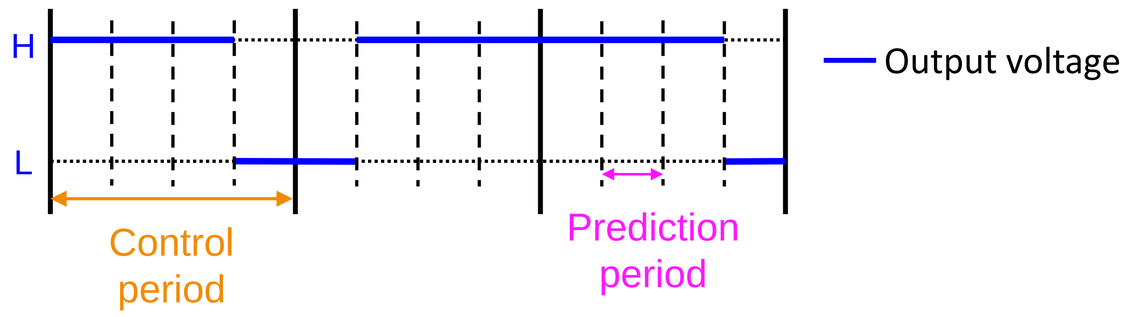
Therefore, we propose method of making minimum pulse width smaller by innovating prediction period

■Current Prediction Flow



In proposed MPC, it is predicted each prediction period on limitation which switching is one time in control period

- Proposed MPC

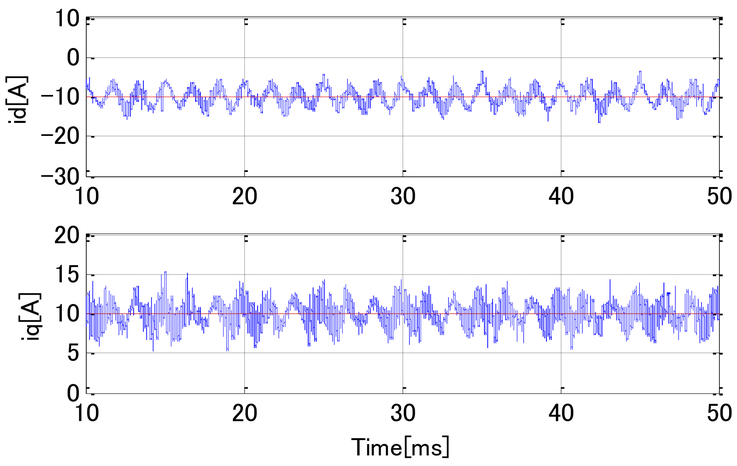


◆Implementations

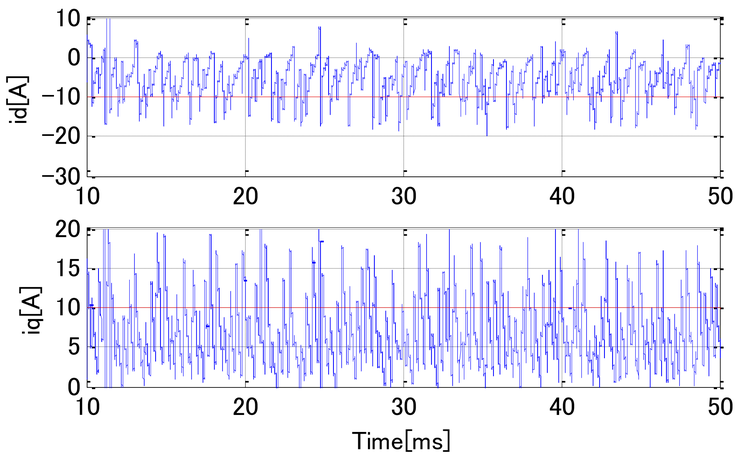
Control period	40μs	d-axis current reference	-10A
Prediction period(Propose MPC)	4μs	Q-axis current reference	10A
Carrier frequency	12.5kHz	speed	1000rpm

current reference
current value

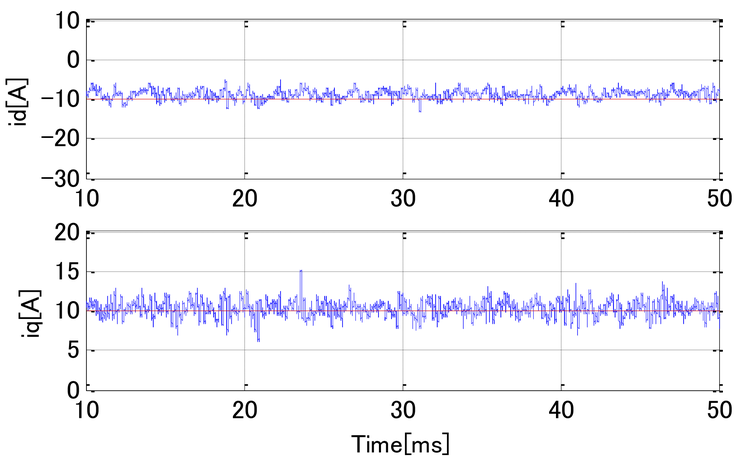
PI control



Previous MPC



Proposed MPC



Reduction of current pulsation is enabled by innovating Predictive period