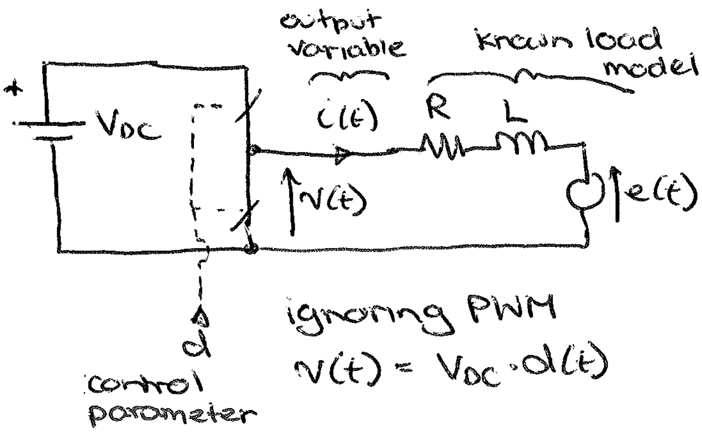
CURRENT REGULATORS FOR VOLTAGE-SOURCE INVERTERS

12R001

18-JAN-12

1. VOLTAGE-SOURCE INVERTER

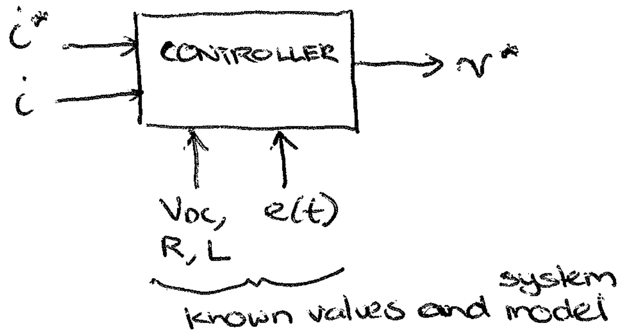
with generic RLV load



ignoring PWM
$v(t) = V_{DC} \cdot d(t)$

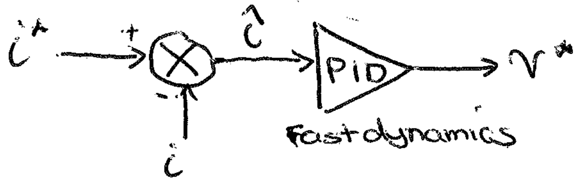
can use duty-cycle to command a desired output voltage $v^*(t)$
where $0 \leq v^* \leq V_{DC}$

desire to get i to track a reference command i^* by controlling v^*



2. FEEDBACK CONTROL

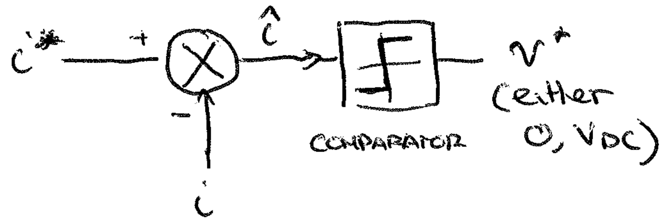
controls output based on <u>difference</u> between actual and command, does not use load model



$$v^* = k_d \cdot \frac{d}{dt}(i^* - i) + k_p(i^* - i) + k_i \cdot \int i^* - i \, dt$$

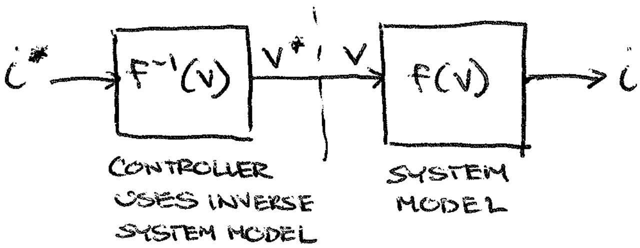
zero steady-state error for DC inputs

extreme case is hysteresis controller



3. FEEDFORWARD CONTROL

controls output based on reference command and system model, does not use actual output value (open-loop control)



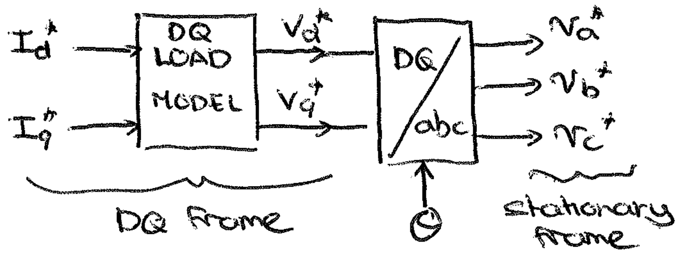
For RLV load, can show

$$v^* = L \cdot \frac{di^*}{dt} + i^* R + e$$

DC current command → DC voltage command

AC current command → AC voltage command

can use d, q current commands for 3ph machines



Feedforward offers good transient performance but prone to steady-state errors due to model errors

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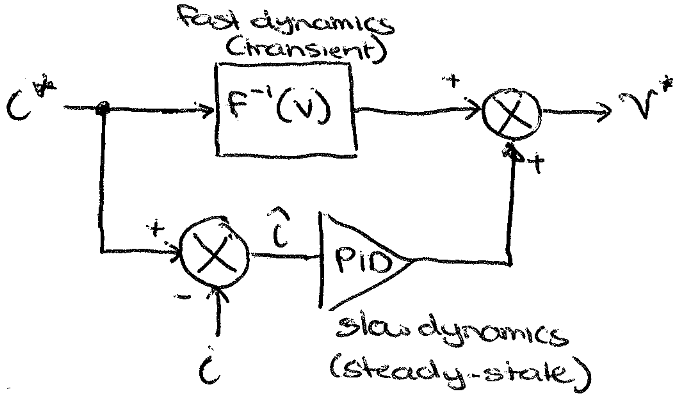
CURRENT REGULATORS (CONT'D)

4. FEEDBACK/FEEDFORWARD

combine methods together



5. STATE BASED CONTROL

state variables define system state (for RLV load i = state variable)

a model based control method which attempts to move system to desired final state

present state i_K ⟶ desired future state i^*_{K+1}

choose

$$V^*_K = L \cdot \frac{i^*_{K+1} - i_K}{\Delta t} + i^*_{K+1} R + e_{K+1}$$

particularly useful for controlling systems which are complex and have multiple inputs and outputs and strong interactions between inputs

simple example, three-phase inverter has three current output variables, but only two are independent