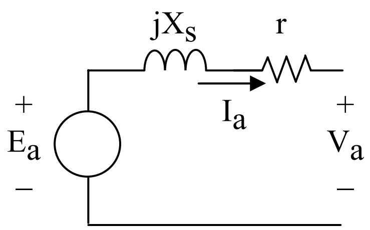
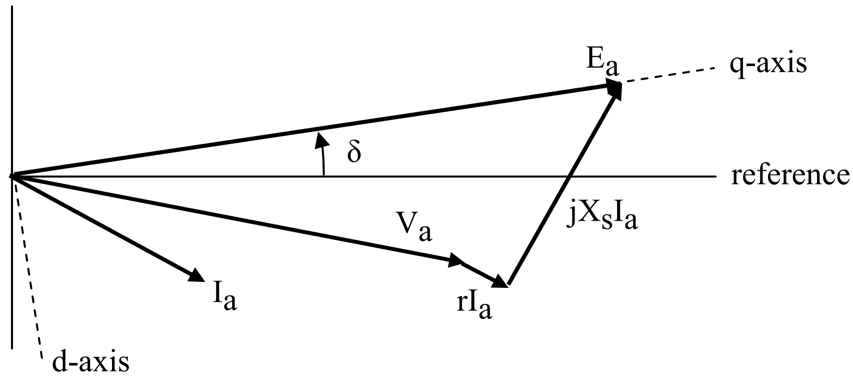
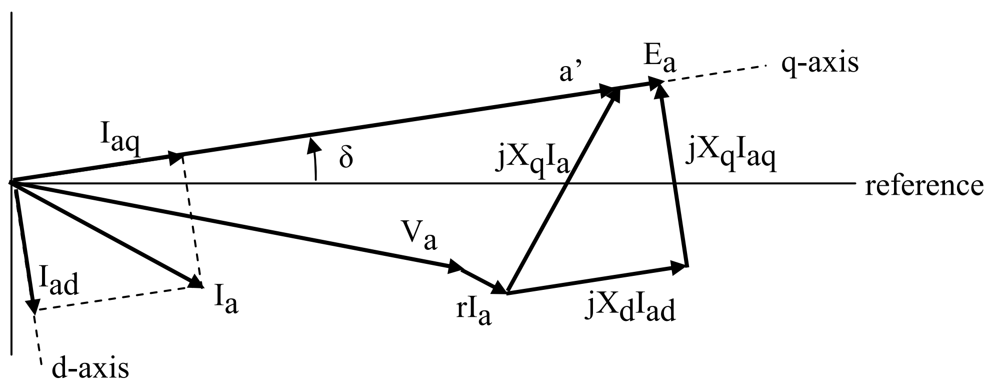
Steady State Model for Round Rotor Machine

V_a and I_a are the terminal voltage and current. X_s is the synchronous reactance. Resistance r is the stator resistance. E_a is the Thevenin equivalent voltage behind synchronous reactance.





Steady-State Model for Salient Pole Machine (No equivalent circuit. Phasor diagram only)

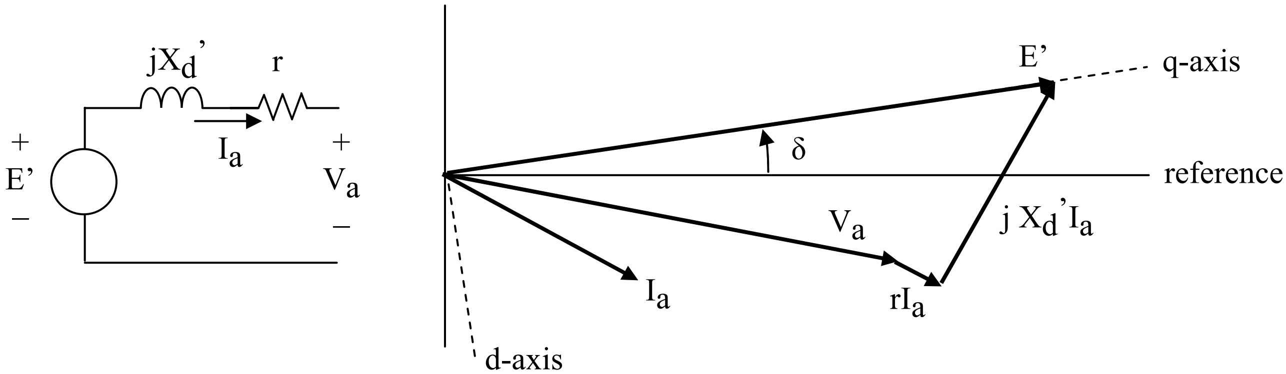


Steps when V_a and I_a are known:

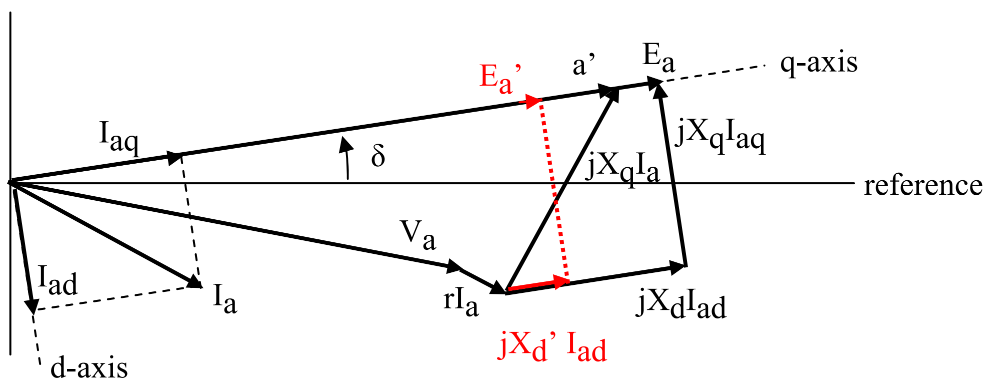
- With V_a, I_a, r, and X_q, find phasor a' to locate the q-axis.
- Then, compute I_a projections I_{aq} and I_{ad} where
  I_{aq} has magnitude $|I_a|\cos(\delta - \angle I_a)$ and has phase angle δ,
  I_{ad} has magnitude $|I_a|\sin(\delta - \angle I_a)$ and has phase angle $(\delta - 90°)$,
  and where $\angle I_a$ is the angle of I_a.
- Then, find E_a.

Transient Stability Machine Model 1
Constant Voltage Magnitude E' Behind Transient Reactance X_d'

This model is like the round rotor synchronous model, except that the transient reactance is used instead of the synchronous reactance.



Transient Stability Machine Model 2
Salient Pole Rotor



Steps when V_a and I_a are known: Begin with same steps used in the salient pole synchronous machine model. Then, use X_d' and I_{ad} to find E_a'.

The magnitude of E_a' varies according to $\dfrac{d\left|E_a'\right|}{dt} = \dfrac{1}{T_{do}'}\left(E_{fd} - \left|E_a\right|\right)$, where T_{do}' is the direct-axis transient open circuit time constant, and E_{fd} is the field voltage (as seen from the stator). As a first approximation, E_{fd} is treated as a constant whose initial value is the same as the initial value of $\left|E_a\right|$.