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Background

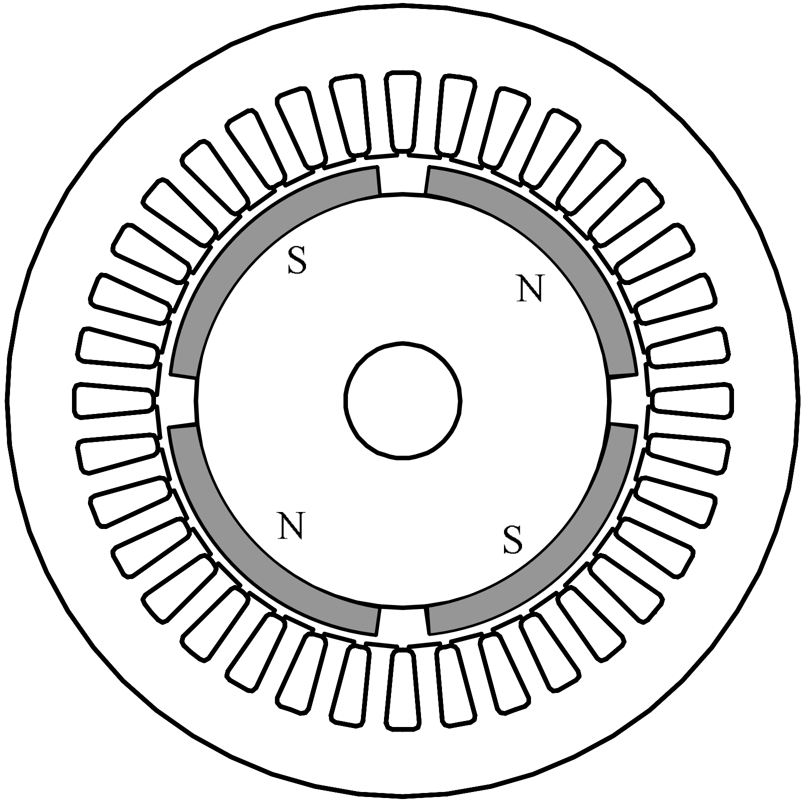
EDUCATION

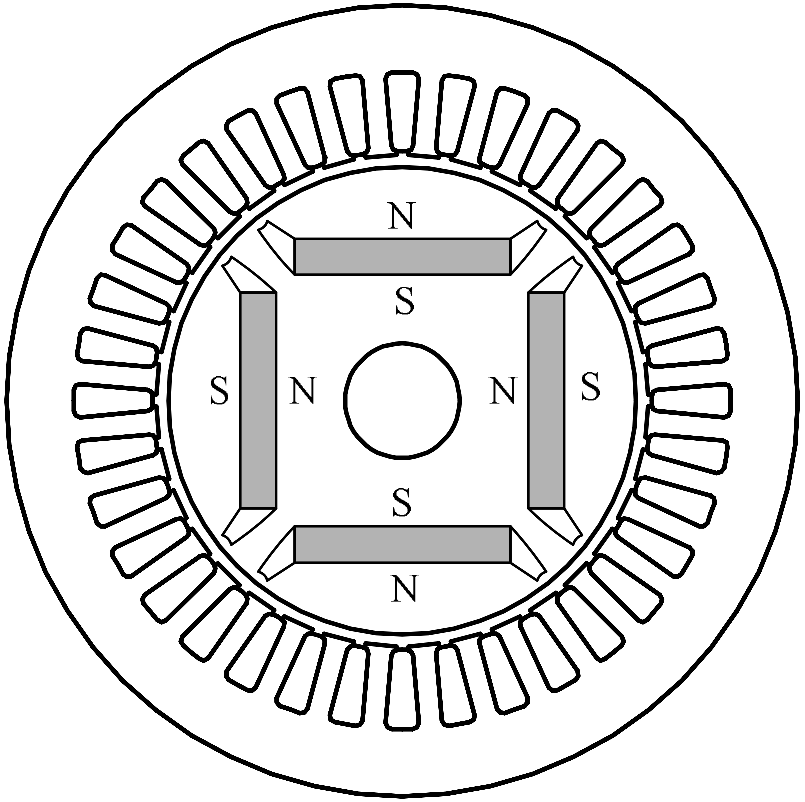
- 2002 Ph.D. in Electrical Engineering, University of Wisconsin- Madison, USA
- 1997 M.Sc. in Electrical Engineering, University of Concepcion, Chile
- 1992 Electrical Engineer, University of Concepcion, Chile

RESEARCH INTERESTS

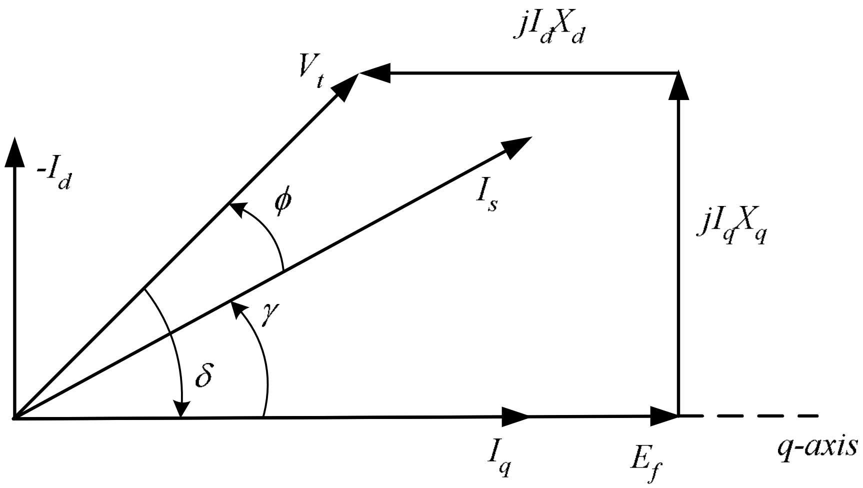
- AC PM Electric Machine Design: New Topologies
- Permanent Magnet Machine Control
- Numerical Solution of Electromagnetic Field

PM machine topologies





Design approach



$$P = n_{pu} E_{f0} I_q + n_{pu} (X_{d0} - X_{q0}) I_d I_q$$

$$T = E_{f0} I_q + (X_{d0} - X_{q0}) I_d I_q$$

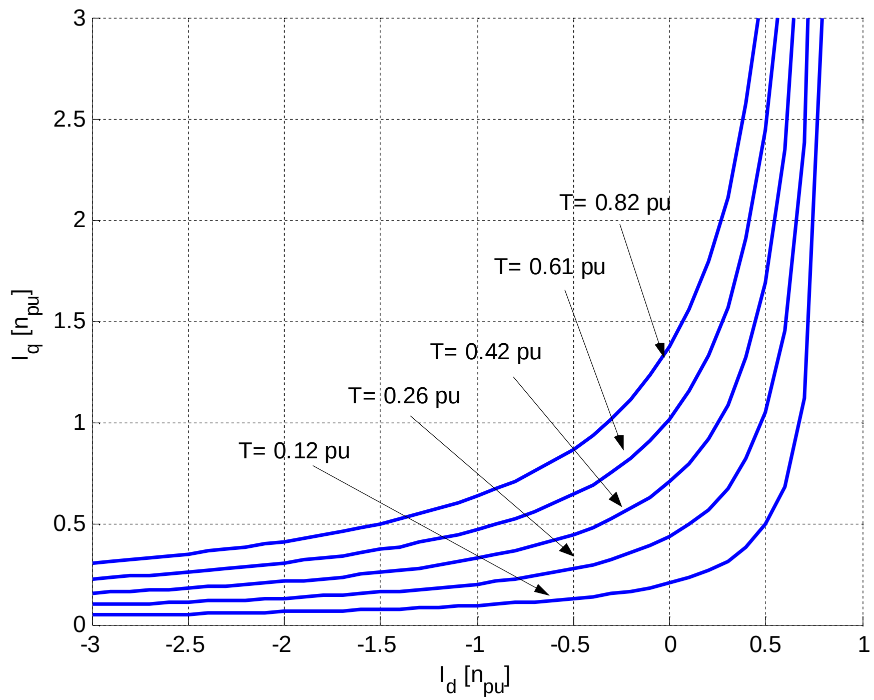
Where

$$E_f = n_{pu} E_{f0}$$

$$X_d = n_{pu} X_{d0}$$

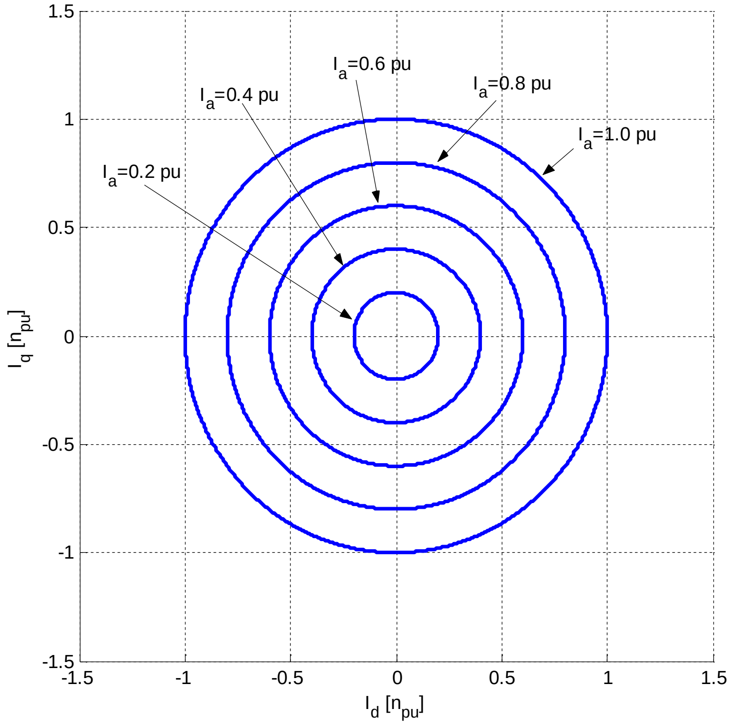
$$X_q = n_{pu} X_{q0}$$

Torque trajectory



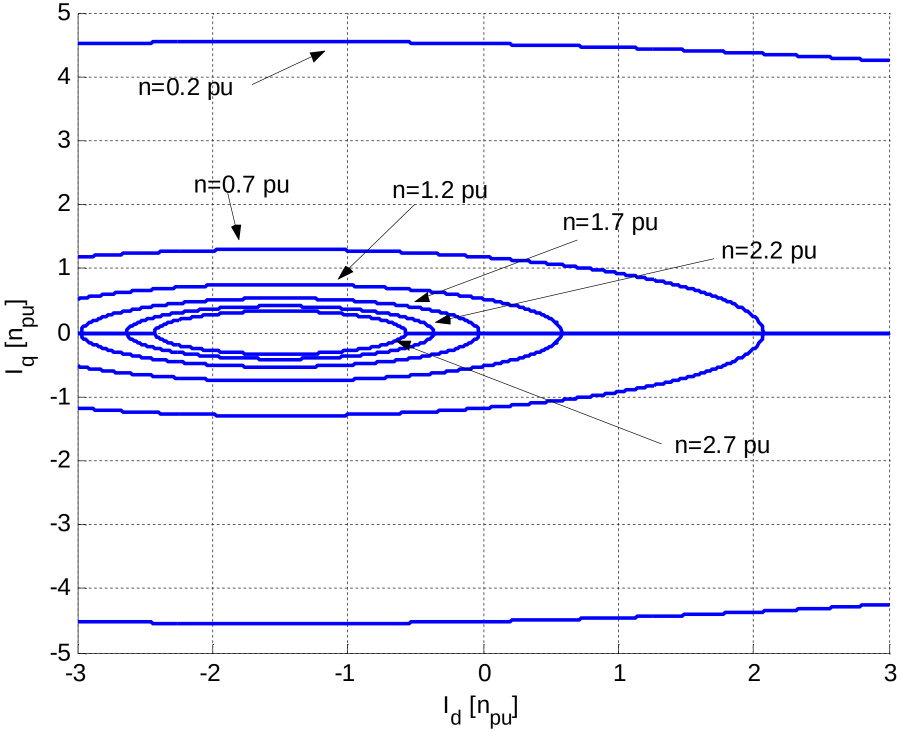
$$T = E_{f0} I_q + (X_{d0} - X_{q0}) I_d I_q$$

Current locus



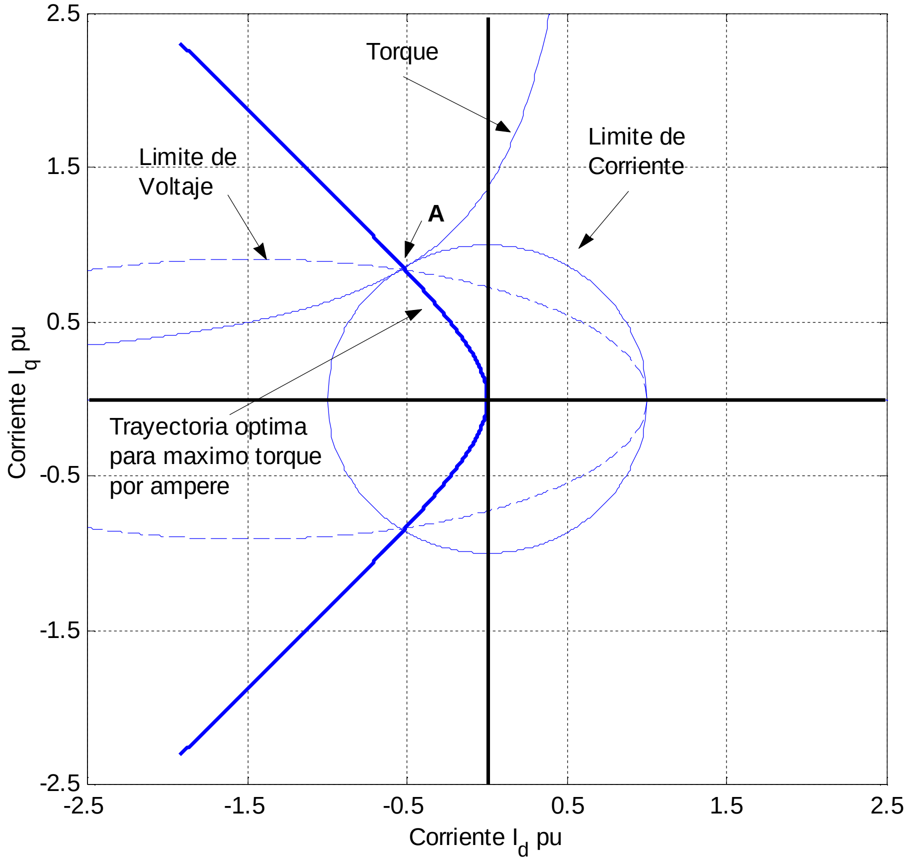
$$I_s^2 = I_d^2 + I_q^2$$

Voltage locus

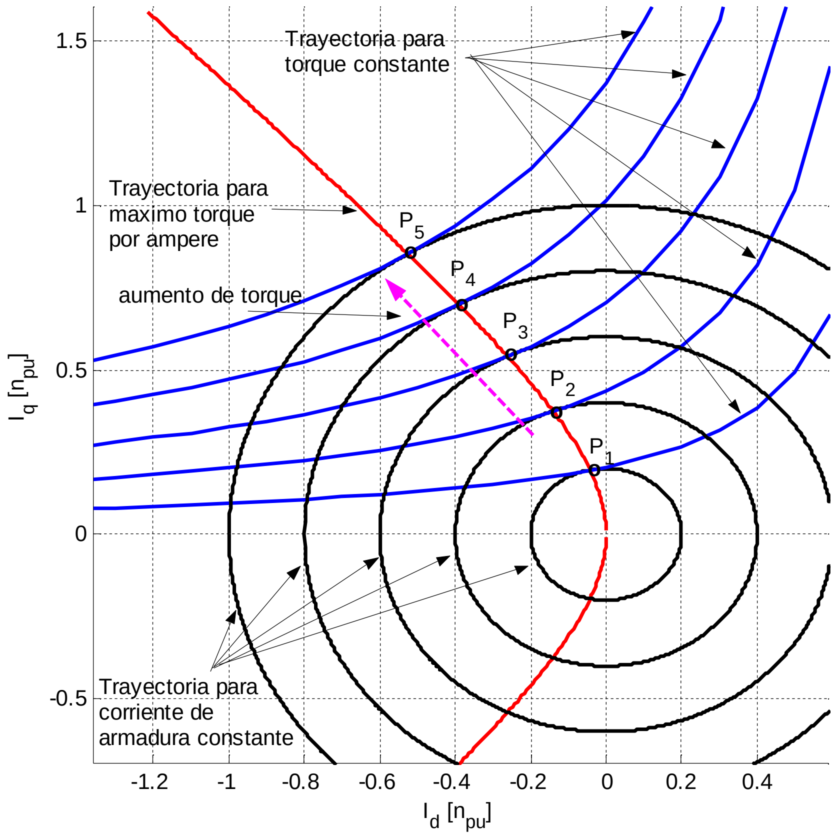


$$\left(\frac{V_t}{n_{pu}}\right)^2 = (E_{f0} + X_{d0} I_d)^2 + (X_{q0} I_q)^2$$

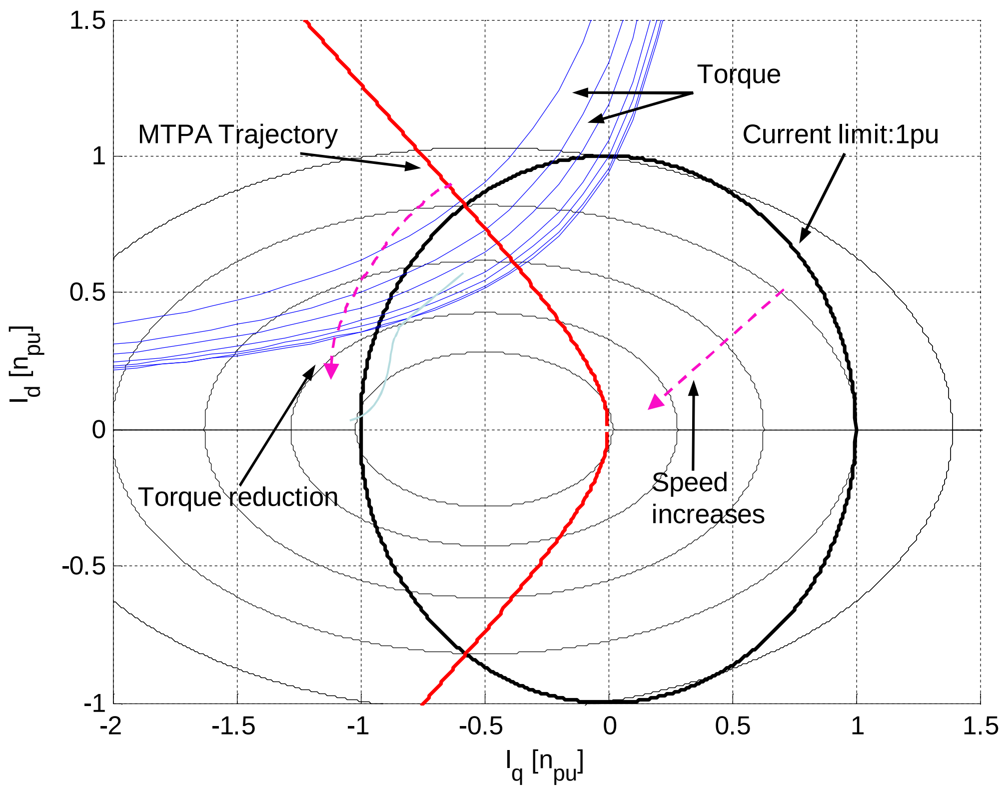
Operational constrains



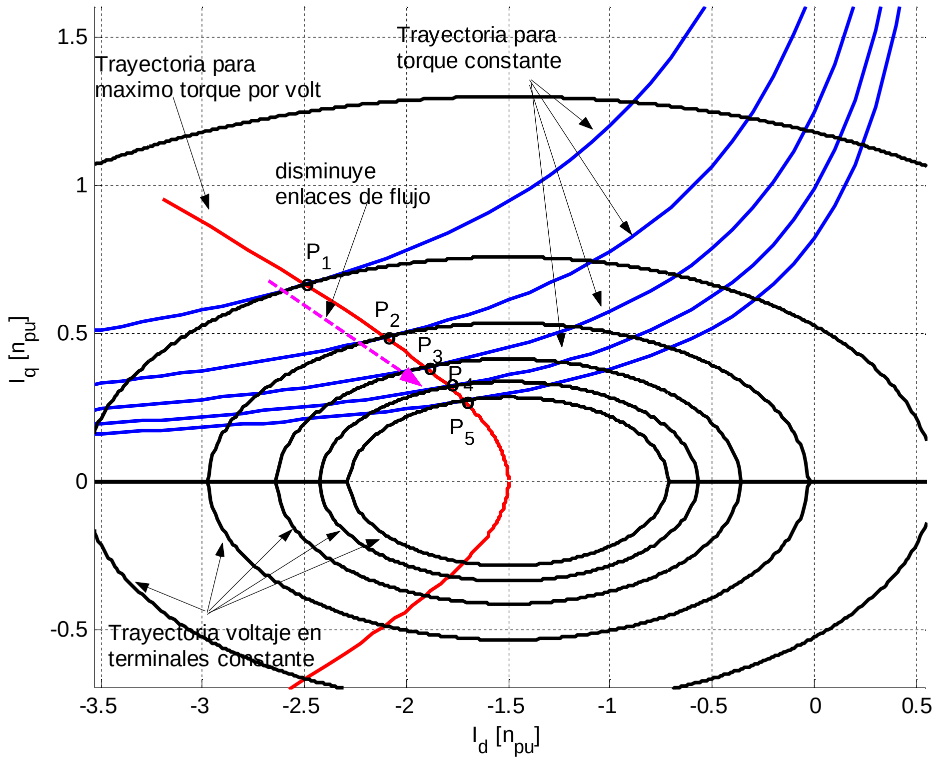
Maximum torque per ampere



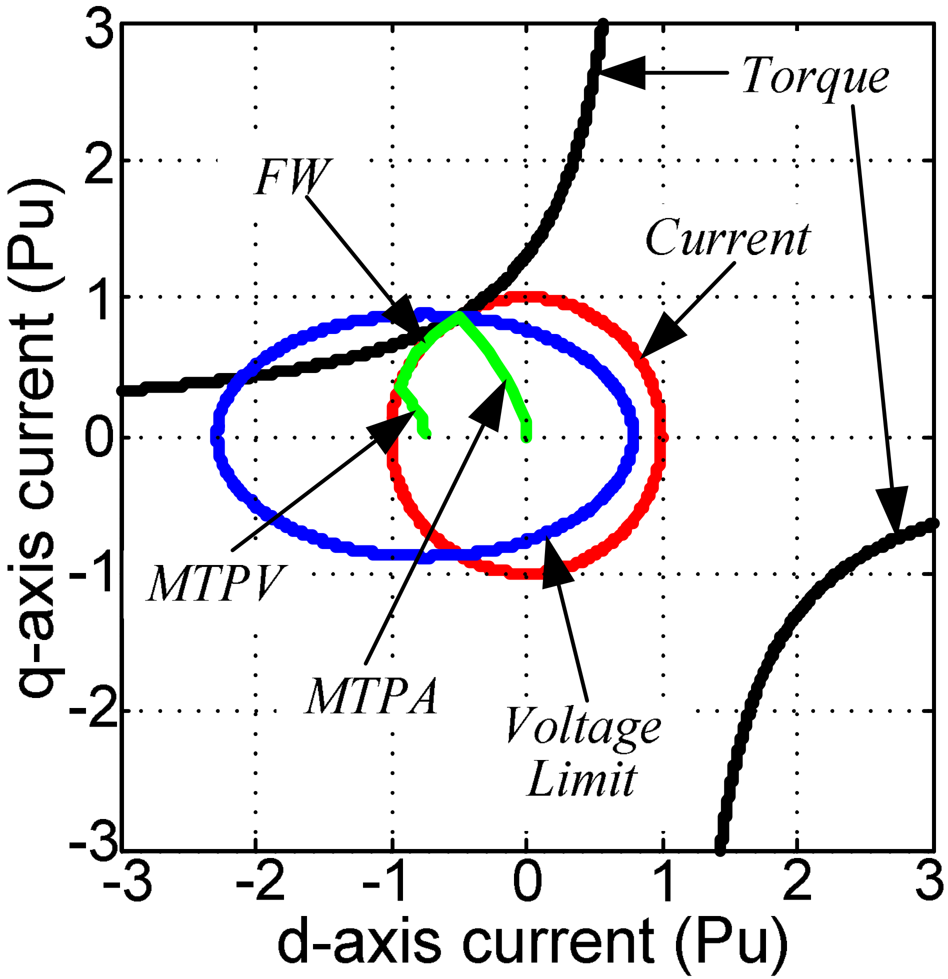
Field weakening



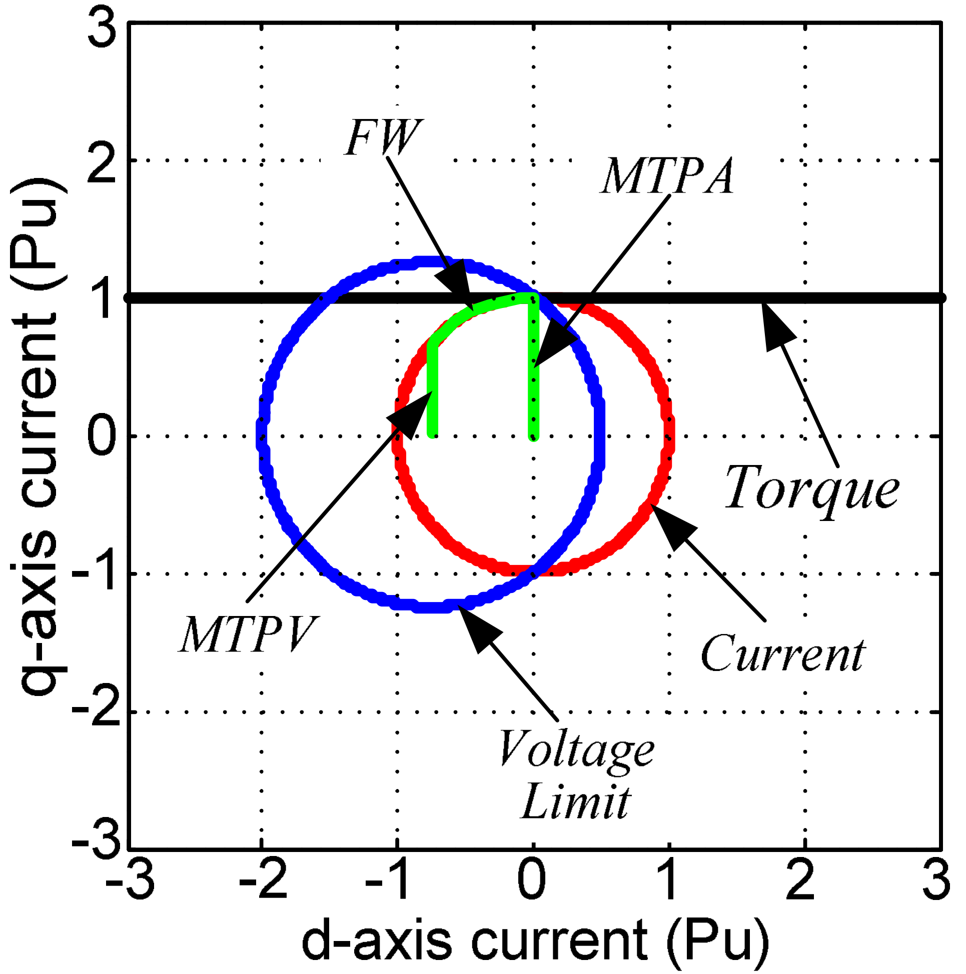
Maximum torque per volt



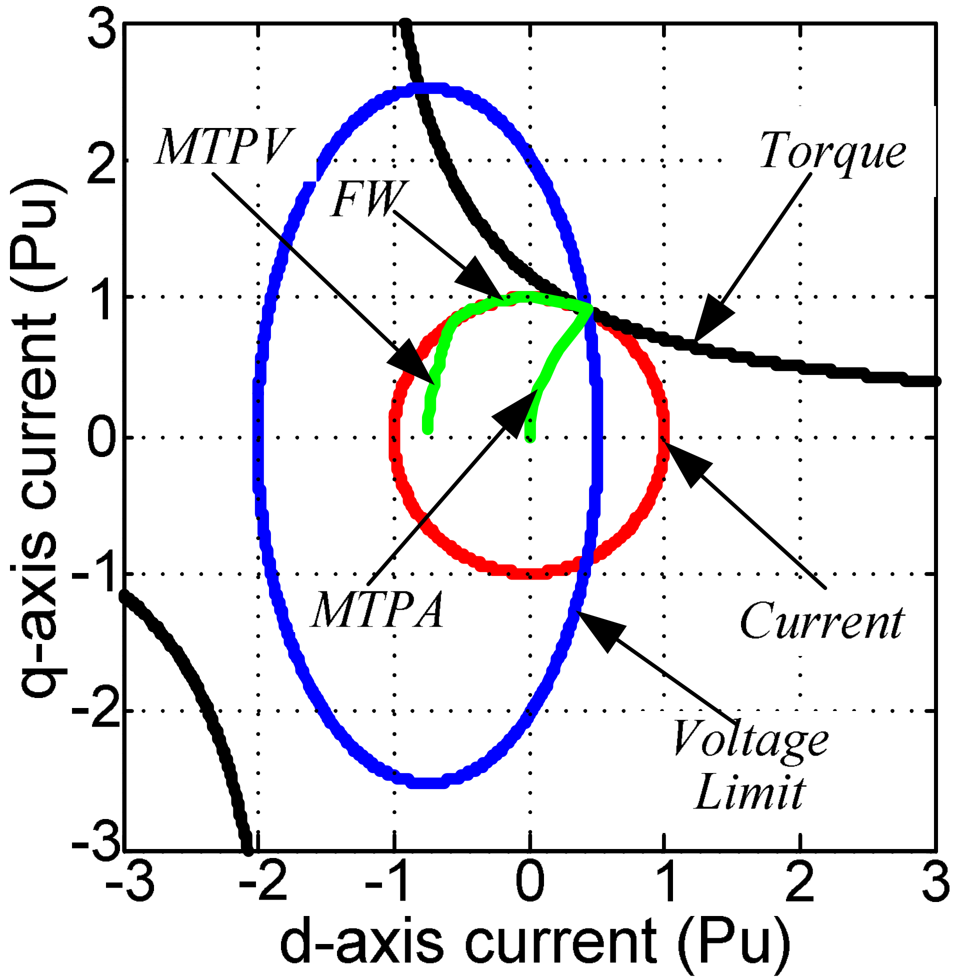
Positive saliency: $X_{d0} < X_{q0}$



No Saliency: $X_{d0} = X_{q0}$



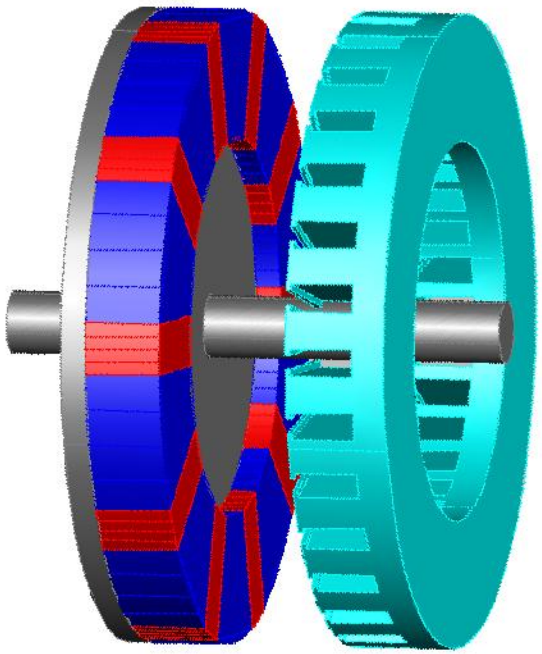
Negative saliency: $X_{d0} > X_{q0}$



Some Prototypes Examples

High Saliency Axial Flux PM Machine

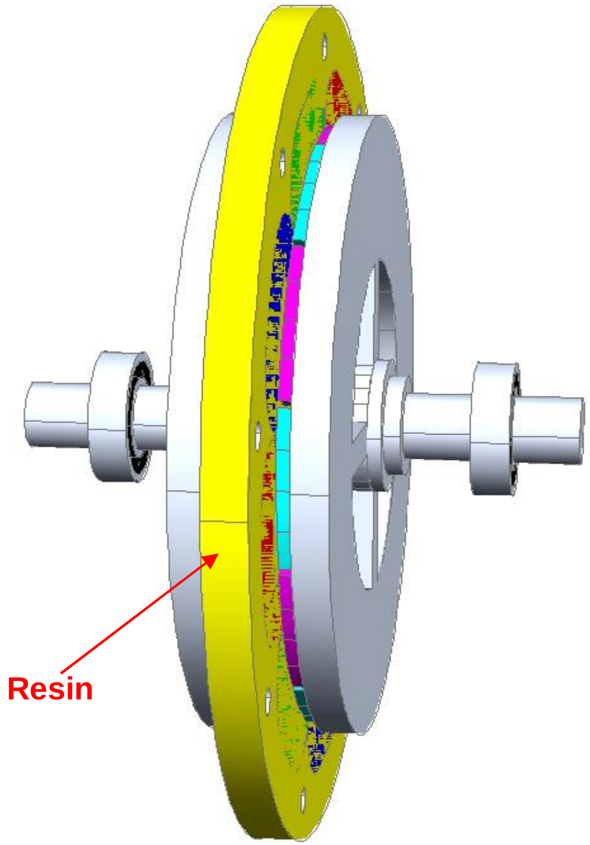
- Tangential PM magnetization to increases saliency
- Reluctance component is optimized to increases output power
- High number of poles (10 poles)
- PM geometry improve stator iron utilization



Some Prototypes Examples

Axial Flux PM Machine with Ironless Stator

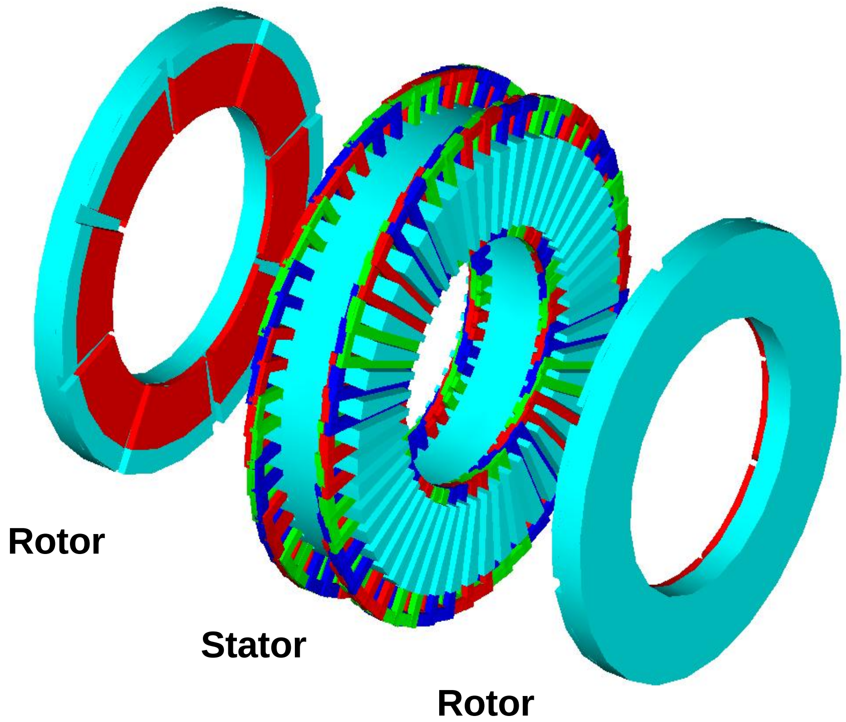
- Stator ironless reduce weight and volume
- Use of fiber glass to fix the stator winding
- High number of poles (12-poles)
- No cogging torque allow us to start power generation at lower wind speed
- PM excitation increases power density ((Watt/m^3 and



Some Prototypes Examples

Axial Flux PM Machine with Field Weakening Capability

- 2x2.5kVA, 8-poles, three phase machine
- Dual rotor-stator configuration
- Magnetically designed for variable speed applications
- Armature reaction is used to control airgap flux
- Exhibits Negative Saliency



- Thanks for your attention…☺