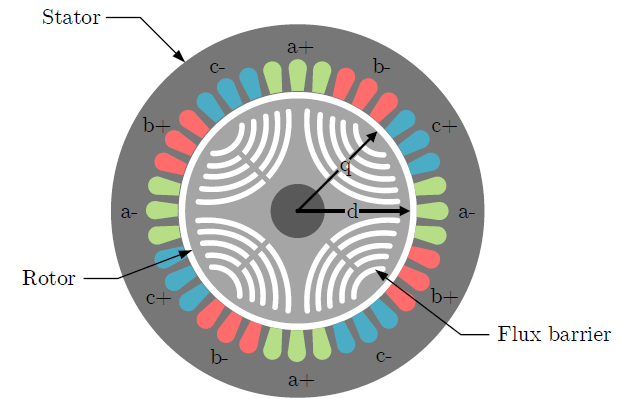
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2.Fundamentals

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2. Motor Fundamentals

2.1 Structure of SynRM

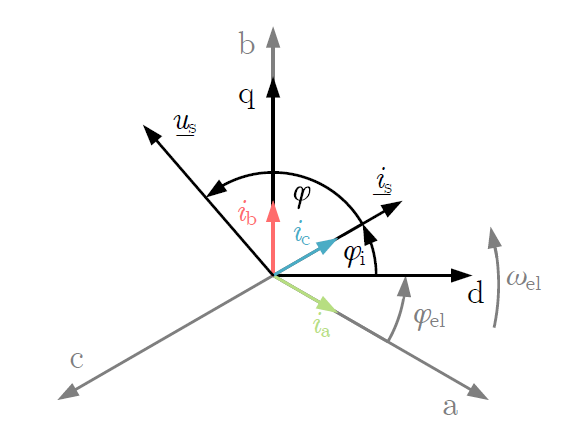


2.2 Coordinate Systems and Coordinate Transformation

In a symmetric three-phase system such as the stator of a SynRm, the electrical variables can be described within the coordination system composed by a,b and c axes. The three axes are fixed to the stator and have a phase shift of 120 degree to each other. For a three-phase system with frequency , the stator current can be described in eq ?

We assume that the system is perfectly symmetric and

For the sake of simplified calculation and better description of the electric variables of the system, the current space vector is typically described in the rotor-fixed coordination system characterized with the d,q axis. This conversion is carried out in two steps with the use of two Transformation.

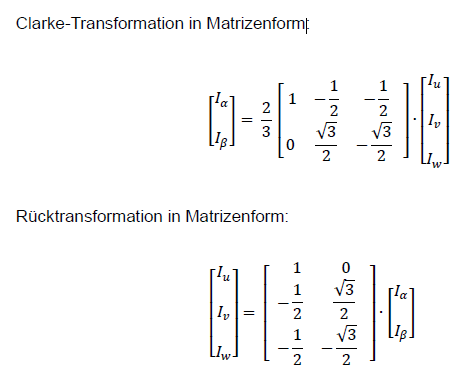


We first transform the current value and into the stator-fixed coordinate system with the use of Clarke Transformation. As figure ? shows, the axis correspond to the a axis. The Clarke Transformation of the stator current is described in equation?

, where

The superscript “S” indicates that the coordination of the current is fixed to the stator. The transformation reduces the three-phase variable into two variables that are defined in coordinate system.

The Matrix form of the Clarke-Transformation and reverse Transformation is showen in eq ?

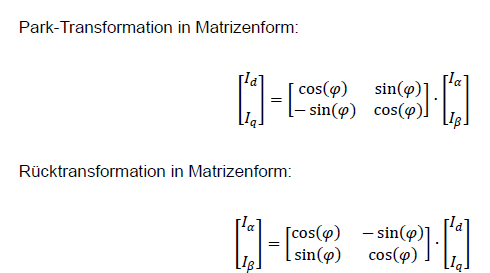


In order to transform the coordination of the current variable form stator-fixed to rotor-fixed, the electrical angle of the rotor needs to be considered. Park Transformation, as described in equation ?, transform the current coordinate system to the coordinate system.

= .

Again, the superscript “R” indicates that the coordination of the current is fixed to the rotor. The current space vector in rotor-fixed coordination system is compsed of d and q commpnent, as described in equation?

The Matrix form of the Park -Transformation and reverse Transformation is showed in eq ?



2.3 Motor Equations

In convention, the equations of the SynRM are described in the dq coordinate system with an obvious advantage. After the conversion of coordinate system via Clarke-Transformation and Park-transformation, the electric variables become direct signals on the d-q axis rather than alternating signals. This greatly simplifies the calculation and thus are used in the design of controller systems.

2.3.1 Electrical angle and Frequency

The electrical angle of the rotor can be obtained through the mechanical angle and the pole pair count , as described in equation ?

The same applied to the angular electrical frequency and

The relation of and are described in equation?

2.3.2 Voltage and Current

In order to obtain the voltage equation in the d-q coordination system, we start with equation ? ,which described the relation of voltage, current and flux in the stator-fixed coordinate system.

=

We obtain the same equation in the rotor-fixed coordinate system by applying the park transformation to equation? . Note that the last term of equation? is derived through the derivation of with time during the transformation.

=

The voltage space vector can be decomposed into voltage components in the d- and q-component. Considering equation? For the magnetic flux space vector, we are able to derive equation ?.

=

=

2.3.3 Power

2.4 Motor Parameters