BRIEF DESCRIPTION OF THE INVENTION

An object of the present invention is to provide a method and an arrangement so as to solve the above problem. The object of the invention is achieved by a method and an arrangement which are characterized by what is stated in the independent claims. Preferred embodiments of the invention are disclosed in the dependent claims.

According to a first aspect of the present invention, there is provided a method of determining inductances of a synchronous reluctance machine, the method comprising supplying a voltage pulse in the quadrature-axis (q) or direct-axis (d) direction of rotor, sampling currents (i_d, i_q) generated by the supplied voltage pulse, calculating values of flux at the sampling instants from the value of the supplied voltage pulse, the sampled current values and the value of the stator resistance, calculating synchronous inductance of the machine by dividing the calculated flux values by the corresponding sampled currents, and/or calculating transient inductance of the machine as a derivative of the flux with respect to current, and storing the calculated values as a function of current, **characterized in that** the method is carried out using a frequency converter connected to the synchronous reluctance machine and the method comprises a step of magnetizing the rotor in a direction perpendicular to the direction of the voltage pulse before supplying the voltage pulse in the quadrature-axis or direct-axis direction of the rotor for obtaining inductance values with cross saturation.

According to a second aspect of the present invention, there is provided an arrangement of determining inductances of a synchronous reluctance machine, the arrangement comprising means for supplying a voltage pulse in the quadrature-axis (q) or direct-axis (d) direction of a rotor, means for sampling currents (i_d, i_q) generated by the supplied voltage pulse, means for calculating values of flux at the sampling instants from the value of the supplied voltage pulse, the sampled current values and the value of the stator resistance, means for calculating synchronous inductance of the machine by dividing the calculated flux values by the corresponding sampled currents, and/or means for calculating transient inductance of the machine as a derivative of the flux with respect to current, and means for storing the calculated values as a function of current, **characterized in that** the arrangement is implemented in a frequency converter connected to the synchronous reluctance machine, and the arrangement comprises further means for magnetizing the rotor in a direction perpendicular to the direction of the voltage pulse before supplying the voltage pulse in the quadrature-axis or direct-axis direction of the rotor for obtaining inductance values with cross saturation.

In the invention, the saturation behaviour of inductances of synchronous reluctance machines is determined with different pulse tests using an inverter connected to the machine. Both synchronous inductances and transient inductances of the synchronous reluctance machine can be determined using a series of pulse tests.

Synchronous and transient inductances are illustrated in Figure 7, which shows a graph obtained during inductance measurement. Flux is plotted as a function of measured current. Synchronous inductance is the slope of the line that is drawn from the origin to a selected point of the curve, i.e. to a point, the inductance of which is of interest. This is a well-known relation: Flux = current*inductance. Transient inductance is the derivative of the flux as a function of current at a given operating point. In Figure 7 this is illustrated by a tangent line drawn at a selected point of the curve. Transient inductance describes the behaviour of the current in the neighbourhood of a certain operating point.

The method of the invention does not require any additional equipment since it can be carried out using an inverter controlling the machine. The inductance values obtained with the method can be directly loaded to the inverter controlling the measured reluctance machine. The method of the invention does not require the rotation of the machine. In an embodiment, the rotor is slightly rotated for aligning the rotor. In case the direction of the rotor is known, the method can be carried out without any rotational movement of the rotor. Since the rotor of the machine is not rotated, the method is fast.

Due to the nature of reluctance machines, stator currents have a considerable influence on the saturation of the inductances. The method provides accurate information on the saturation behaviour. Once the accurate saturation behaviour is adapted to use in a motor model of the inverter or frequency converter controlling the machine, the control of the synchronous machine is accurate and reliable.

In the method of this invention, the saturation behavior of inductances of a synchronous reluctance machine is measured using simple pulse