The Institute of Energy Systems and Electrical Drives was merged in 2011 from the institute of "Electrical power systems", "Electrical drives and machines" and the "Energy economics group". Our department is active in the area of the design of electric machines, as well as their regulation. Of course the power electronics may not be disregarded in the drive technology.

Due to the trend of repairing components just before a problem arises, monitoring is also a topic in our field of research. One domain is the monitoring of induction machines where the squirrel cage is examined for a breaking bar. In the view of life time, the inverter's weakest component is the DC link capacitor. So another domain is the monitoring of these capacitors of an inverter without additional components in the power path of the inverter.

Fig.: Dental drive with INFORM

The main focus of our research is the highly dynamically sensorless control of permanent magnet synchronous machines (PMSM). Sensorless means you do not need any mechanical speed or position sensor. At high speed we use the well known back EMF method. At low speed and at standstill this model will not work due to the lack of the stator voltage. So we developed the so called INFORM method which uses the machine itself as a sensor. Therefore some test pulses are applied to the machine and the response can be used to calculate the actual angular speed of the motor shaft which is needed for a field orientated control of the PMSM. Latest developments are aimed to include these test pules into the normal operating mode. So the noise of the INFORM test pulses will be negligible.

Fig.: Prototype inverter design

The INFORM method is independent of the size of the motor. As an example for small drive applications, we implemented the INFORM method together with a dental company in their products. So we solved their former problem of damaged Hall sensors during high temperature sterilization (Hall sensors can be used for the field orientated control of the PMSM). Now they are able to cover the whole range of speed with one drive and can serve additional applications where full control of speed and torque is needed. As a high torque application example, we designed a traction machine for propulsion with the scope of good sensorless properties. So the drive is able to be highly overloaded and even be controlled without sensor. In the figure the 4kNm prototype is shown.

Fig.: 4000 Nm traction drive

As mentioned, the INFORM method is independent of the size of the machine. We are able to control small machines with a few mNm at very wide speed range up to torque motors in the range of several kNm at low speed. Therefore no speed or position sensor is needed even at low speed and standstill.