Having fun with a quick image processing and highly dynamical drive

Dipl.-Ing. Lars Nagel; Gerd Wahlers

Prior to the Soccer World Championship 2006 in Germany a team, headed by Prof. Dr. Michael ten Hompel, combined the know-how of Fraunhofer IML and the Chair of Materials Handling and Warehousing of the TU Dortmund to develop a robot-like automatic goal keeper. The result was the "RoboKeeper" which functions like a classical Tipp-Kick goal keeper. However, the RoboKeeper can automatically hold on to the ball, even a penalty kick, with an acceleration faster than that of any Formula 1 racing car.

The system consists of a goal keeper dummy equipped with an efficient and dynamic motor-drive combination. The drive is connected to the motor control, two cameras, an image processor and the respective software.

The sensors identify the ball because its colour is in contrast to the surroundings and the cameras track its curve with 60 images/second each. Based on these data the image processing software determines the potential point of impact in the goal and transmits these data to the motor control unit which moves the dummy at the required angle.

For the first calculation of the point of impact two camera takes are necessary. At a speed of 100 km/h the first value is transmitted to the motor control of the dummy after 90 ms and a trajectory of 2.5 m. The drive then needs another 300 ms for the longest distance (max. 90°). So, the Robokeeper has no problem to hold on to a ball which is kicked at a speed of 100 km/h from the penalty spot, thanks to an aircraft drive, an acceleration of 20G (and thus by 17 times higher than that of a Formula 1 racing car), 16 PS and a balance weight of 800 kg.

The requirements onto the dynamical behaviour of the plant, changing lighting conditions and the impact of the shot transformed a single penalty kick into an exciting scientific task. At least, the RoboKeeper has less than half a second to perform all these complicated steps before it can hold on to the ball.

In the meantime, the system has been developed further so that the module can now be used anywhere at any time. The RoboKeeper impressively proves the competence of Fraunhofer IML in the field of control technology and image processing in robotics.

www.robokeeper.com

RoboKeeper: Master of the goal!
RoboKeeper: der Elfmeter-Töter.