Mechatronics Demonstration Rig

Björn Lineke, IEA, LTH, March 2011

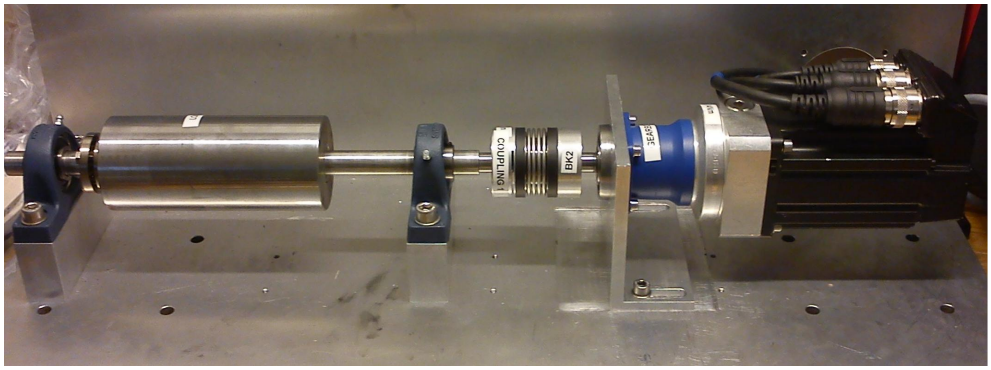

Figure 1: The mechatronic demonstration rig

As more systems get converted from purely mechanical to an integration of mechanical and electrical, mechatronical education of people working with these systems is necessary. The mechatronics demonstration rig provides a platform for this education. Figure 1 shows a basic hardware setup.

When constructing complex machines today, more and more electronic equipment is used. This puts a high demand on the knowledge of the people constructing these systems. Although many of the engineers working on this have a good and solid background on either mechanics or electronics, people who understand both worlds are few.

It is easy for an engineer with a background in mechanics to understand the differences between different gearboxes, couplings and how their properties affect a system. But when using a high precision servo motor and understanding what properties that brings is not always clear for the same person.

The mechatronics demonstration rig and the software to control and analyse data give these engineers a place to sit down and get hands-on experience of what a system like this can do and how the system reacts to different settings and hardware.

The rig is equipped with a servo motor, three different gearboxes, two bellow couplings, one elastomer coupling with three different properties, four shafts and six loads. The loads act as different sized flywheels, ranging from (in comparison to the servo motor) very small (undersized) to large (oversized).

With the opportunity to change all these mechanical properties, the rig allows the user to define very many

combinations to extract the required data for analyses.

Once the data have been collected from a test, different analysis tools can be applied to the data to find pros and cons of the current setup. Not only the mechanical properties have an effect on the system, but also how a user defines software CAM-profiles[1] has a major influence on the performance.

There are numerous ways in designing CAM-profiles nowadays, for better or worse. Some ways are very complex and demands very much CPU power to calculate, but give great results, some are easy to make but wreck the mechanics. Using the rig to get a deeper understanding of these designs will increase the overall efficiency when constructing machines and keep the downtime and service to a minimum.

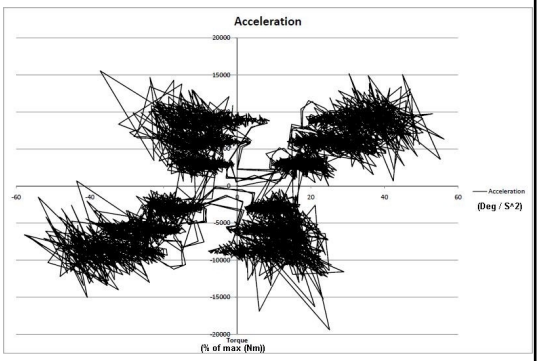

Figure 2: Test run with Trapzoidal CAM-profile

Seen in figure 2 is a test run with a Trapezoidal CAM-profile where the torque almost reaches 60 percent of the servo maximum. In comparison, figure 3, shows a case using a ModSine CAM-profile where the maximum torque just passes 50 percent. In both examples the servo performs the same motion, only with different profiles. For a machine with twenty servos this can make a significant difference in more than terms of energy consumption and also on the sizes of the servos used.

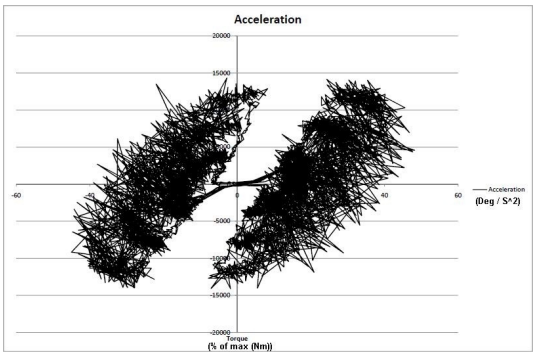

Figure 3: Test run with ModSine CAM-profile

The interface by which the user controls the rig and performs the analysis is implemented in Excel. All necessary commands and controls are directed with macros written in Excel, which send commands and values to the PLCs[2] CPU via DDE[3] links. This makes it possible for anyone to use the software without any additional software installed.

Hopefully this rig will give a solid ground for developers to improve their knowledge about mechatronic systems. With this knowledge they can improve more complex systems and thereby, in the long run, keep the machines as efficient as can be.

For more information about this rig, go to www.iea.lth.se and access the complete report in "Publications" and "Master Theses".

[1] Motion profile for the servo to follow
[2] Programmable Logic Controller
[3] Direct Data Exchange