SOMMACT Self Optimising Measuring MAChine Tools

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Deliverable D3.3

Study on the different types of long-term stable sensors, including electronic levels, to measure machine component deformation

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1) **R** = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other

2) **PU** = Public, **PP** = Restricted to other programme participants, **RE** = Restricted to a group specified by the consortium, **CO** = Confidential, only for members of the consortium

Executive summary

During the first year of the SOMMACT project, different sensors have been studied with respect to their possible integration in various machine-resident reference systems. The sensors shall be each suited for one or several of the following different applications:

- To measure the change of distance between specific points of the machine structure which may have distances of up to the complete length of the machine axes ("extensometers"); for this application the sensors must be very long-term stable;
- For the measurement of relative position between a slider and a reference beam with discrete targets in up to 6 degrees of freedom, normally composed of several sensors with each detecting either 1, 2 or 3 degrees of freedom;
- For the measurement of relative position between a slider and a reference beam with continuous targets up to 6 degrees of freedom, normally composed of several sensors with each detecting 1 or 2 degrees of freedom.

The following sensors were selected from possible candidates and experimentally studied:

1. Capacitive distance sensors;
2. Inductive distance sensors (Eddy current sensors);
3. Laser triangulation distance sensors;
4. Cameras as 1D and 2D sensors in combination with a number of different targets;
5. Commercial electronic levels and a self-designed electronic level on the basis of camera sensors and ball targets;
6. Incremental scales for thermally invariant position measurement.

The following special developments were made and/or studied:

7. The installation and test of incremental scales on thermo-mechanically invariant carbon fibre substrate on a test machine (X, Y, Z);
8. A biSLIDER method with a thermo-mechanically invariant spacer to measure the thermal compensation factor.

The main results were:

a) Technically, the sensors studied were all suited for the purposes they were thought to be used; all are capable of measuring with a short term uncertainty of 1-2 µm; cameras were found not to be long-term stable; a suggestion was made to improve the long-term stability of cameras.

b) The preferences, among the studied sensors, are chosen according to price, ruggedness in use and ease of integration:

   – Inductive sensors for the 1D extensometer application;
   – Camera sensors for the 2D measurement of targets on reference beams;
   – Incremental scales on carbon-fibre rods as position measuring devices;
   – Electronic levels as alternative reference systems.

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