Adjustment robot for fibre optics assemblies

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Fig. 1:
Impulse drive

In cooperation with Agilent Technologies, a manufacturer for communications and life science equipment, Fraunhofer IOF developed a robot for the adjustment of a mono-mode fibre assembly. The major tasks of this project were the development of a fully automated adjustment technology for a fibre optics assembly with minimal attenuation, the visualisation of the robot's operating states, high process stability and certification of the technology for CE-conformity.

Technological solution

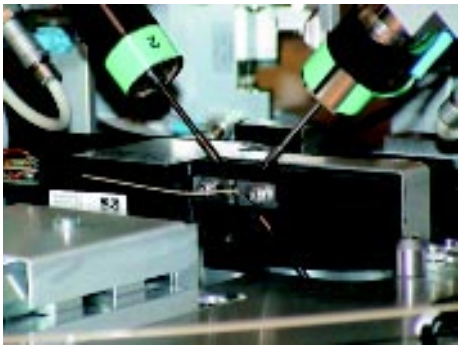

Fig. 2:
Fine adjustment with impulse drive

The main idea of the robot is the adjustment with the help of an impulse drive which was developed by Fraunhofer IOF: The movable parts of electromagnets transfer measured strokes either directly to the part that needs to be adjusted or indirectly on its mounting. The strokes (intensity, number and direction) are controlled by a measurement system and a software algorithm.

With the help of the electromagnets the fibre flanges are moved in the x- and y-direction. The dynamics of the adjustment system are designed to have large increments for coarse pre-adjustment and sub-micron increments for fine adjustment movements. Furthermore the software algorithm allows the consideration of different pre-stressing and friction coefficients between the adjusted part and its mounting. With the components already being fixed before the adjustment takes place they meet the strong demands for telecommunication devices at shock and vibration.

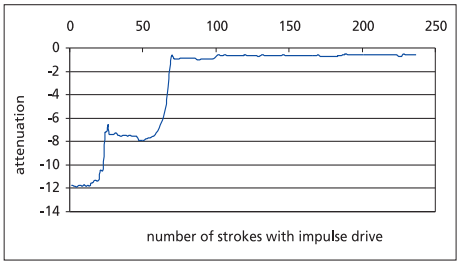

Fig. 3:
Minimizing of attenuation

The pre-adjustment of the fibre flanges and the coarse adjustment of the whole optical system is measured by the position of a transmitted laser beam in front of an infrared camera. Image processing algorithms detect the position and the size of the laser spots and control the adjustment towards the target parameters.

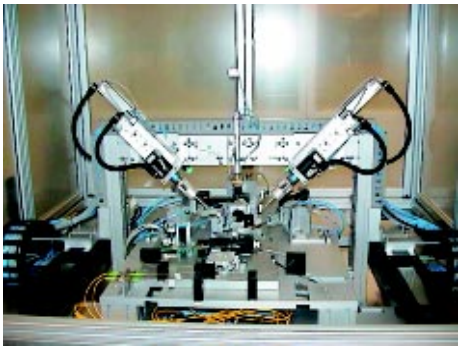

Fig. 4:
Partial view of adjustment robot

The fine adjustment is exclusively controlled by measuring the attenuation of the total system and minimizing it by adjustment. This process takes only few seconds.

Results

An adjustment robot was developed that automatically adjusts a fibre optic assembly completely. The user of the robot only needs to insert the pre-assembled optical device at the beginning and take it out at the end. Further assembly steps (e.g. an additionally fixation of the adjusted components) are not necessary.

By the usage of a deterministic adjustment procedure the entire adjustment including various measurements takes only a few minutes. The achieved adjustment accuracy for the fibre optical assembly is in a low micron range for the beam axis and in a submicron range perpendicular to it.