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Determining 6DOF

A-TOM - a low-cost module for range enlargement of low-range systems

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Abstract:

The workspace of close range 3D-scanners, cameras and CCM-arms is naturally limited, but the object size often exceeds these limits. For enlargement of the workspace, these measuring tools need to be re-positioned. Therefore, precise 6DOF navigation of the measuring tool is needed. Mostly, a laser tracker is available for 3D-positioning, but 6DOF-equipment is often missing and/or too expensive. Therefore, we developed A-TOM (**A**dapter for **T**racking **O**ptical **M**easurement systems). A-TOM delivers all six degrees of freedom from polar data measured by a laser tracker. Hereby, the interferometric mode can be used, because it is not necessary to reposition the laser tracker beam to different reference points.

A-TOM consists of a small motor-powered and well supported rotating arm with an angle encoder. An ordinary reflector (CCR) is mounted at the end of the arm. The laser tracker can determine this circle described by the rotating CCR. The circle fixes five degrees of freedom by the three center coordinates and the two spatial orientation parameters of the circle's plane. The sixth degree of freedom is given by a declared increment edge of the angle encoder, because this increment edge of the encoder signal triggers the laser tracker measurement. The equipment is designed for mounting on several measuring tools. Patent is pending.

Test measurements with a Leica Absolute Tracker (AT901) at different distances and revolution speeds of the CCR show a high internal accuracy. Measurement repeatability of the A-TOM system is small. E.g., at a distance of 24 m the internal accuracy of the center of circle is about 15 µm and the measurement repeatability about 80 µm. The measurement repeatability for the orientation is about 500 µrad (roll angle) and far less for the other two orientation parameters. The 6DOF parameters can be made available by appropriate evaluation routines in almost real time.

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