Conception and Construction of a 3 DOF Optical Precision Sensor Integrated in Micro-Robots

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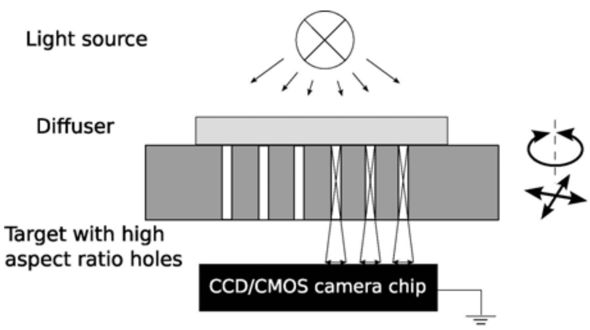
Today's mobile micro robots can achieve very high resolutions. However, there is virtually no 3 DOF sensor that allows to measure a large range in θ_z (360°) that is cheap and small and that can be integrated in these robots.



Construction of the proposed 3DOF sensor

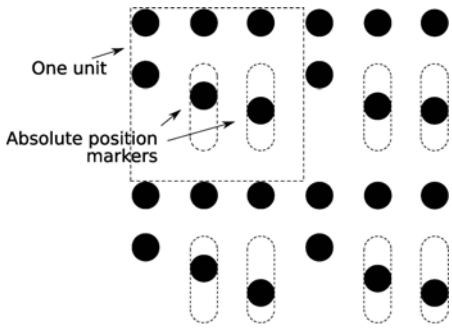
We develop a sensor with a range of $30x30mm^2$ in x and y (for our application). However, this range can be easily extended. An angular range of 360° is obtained. We minimize the sensor thickness by not using the camera optics. This forces us to use high aspect ratio holes in order to get a high contrast image.

	Range	*Resolution (noise)*
x, y	*30x30mm²*	*<±186 νm*
θ_z	*360°*	*1.4'*

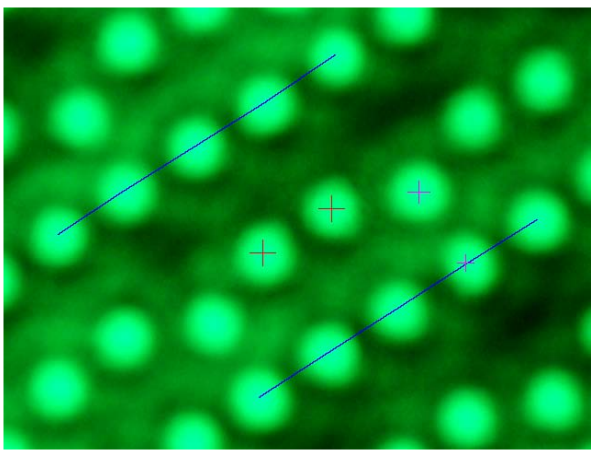
Range and obtained noise

The absolute position is coded by an array of units, whose coarse position is given by the relative position of two holes in comparison to the regular part of the unit.

We obtain a position noise resolution in X and Y of ±186nm and an angular noise of 1.4'. A processing speed of 8.4Hz is obtained on a Pentium IV processor. The decoding algorithm takes only 1.4ms to calculate the position out of a pretreated image.



The absolute position code; the relative position of the two absolute position markers defines the position of the unit



Detection of the different components of the absolute code on a target