Supported by:

Federal Ministry for Economic Affairs and Energy

on the basis of a decision by the German Bundestag

ZIM Zentrales Innovationsprogramm Mittelstand

Technische Hochschule Wildau
Technical University of Applied Sciences
WILDAU

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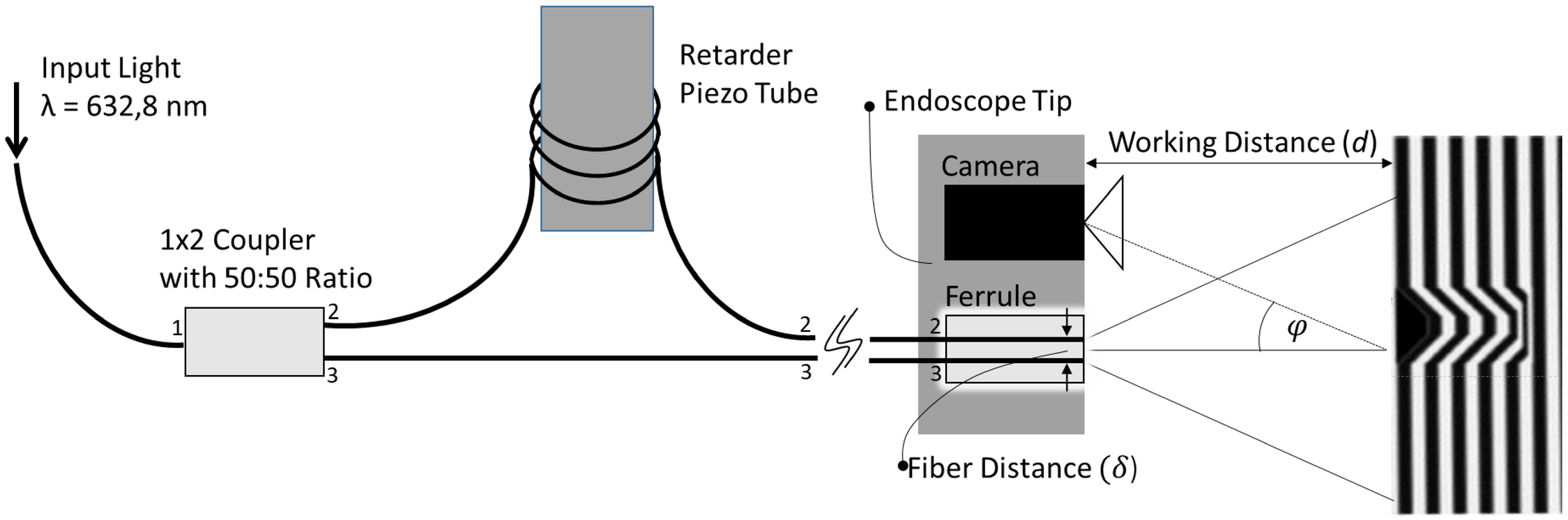
Dynamis

Dynamic pattern generation by singlemode fibers for endoscopic 3D measurement systems

Idea and Concept

This work presents a 3D measurement concept based on *fiber-optic interference fringe projection*. It is based on the radiation of two (or more) neighbored singlemode fibers, whose behavior is close to a Gaussian beam. It creates due to slightly different wavefront propagation vectors, a line pattern inside the overlapping interference volume. Hereby, the spatial frequency of the fringe pattern at the object plane depends on the distance between each individual optical fiber (δ), the wavelength (λ) of the coupled light source and the distance to the object plane (d).



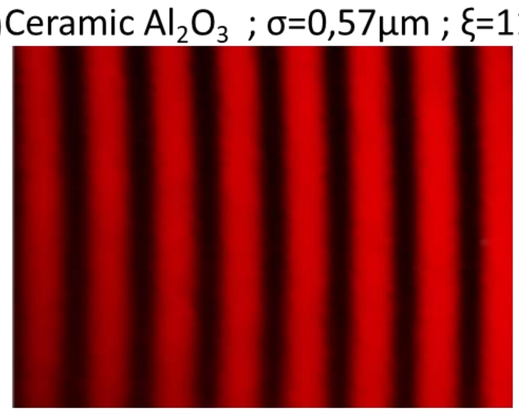
The generated line patterns are basically Young's fringes and can be seen as parallel fringes with a distance described by $\boldsymbol{\Delta y = \lambda\, d/\,\delta}$. In general, the intensity distribution of the projected pattern onto the object plane and captured by a camera positioned at a triangulation angle (φ) can be described as $\boldsymbol{I(x,y) = cos\left\{\frac{2\pi\delta}{\lambda d}\left[x\, cos\varphi + z_0(x,y)\, sin\varphi\right]\right\}}$.

To implement that approach into a micro-optical 3D measurement system we used a capillary based fiber mounting approach in combination with a stainless steel ferrule.

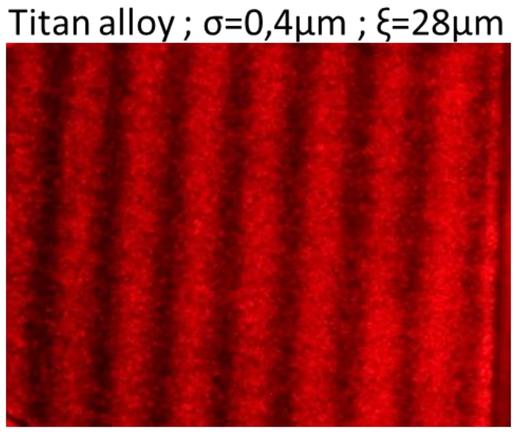
First Results

Influence of Surface Parameter

a)Ceramic Al_2O_3 ; σ=0,57µm ; ξ=11µm



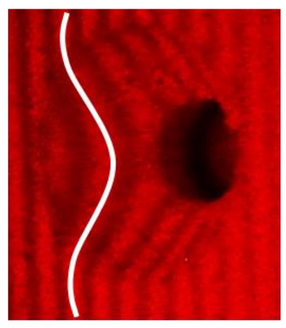
b) Titan alloy ; σ=0,4µm ; ξ=28µm



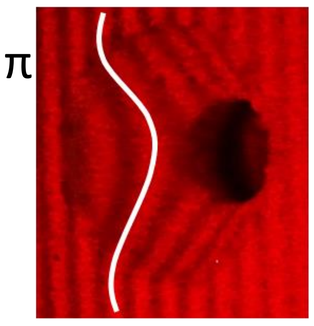
σ – rms roughness
ξ – correlation lenght

Phase Shifting

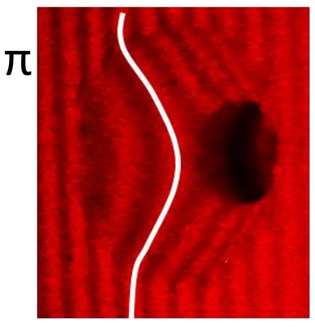
Ref



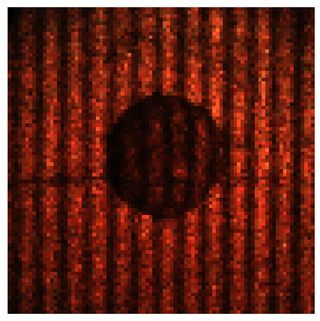
$+\frac{2}{3}\pi$

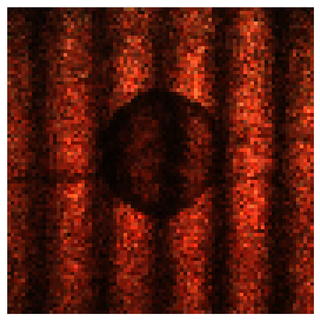


$+\frac{4}{3}\pi$



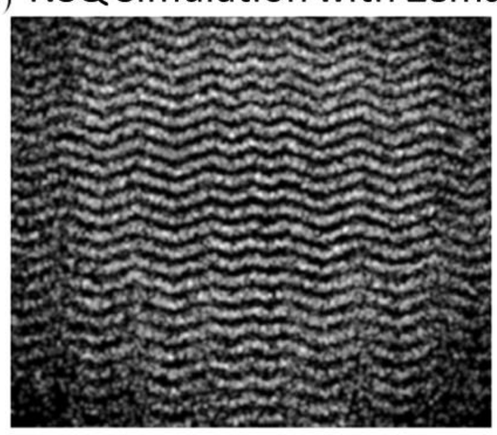
Spatial Frequency



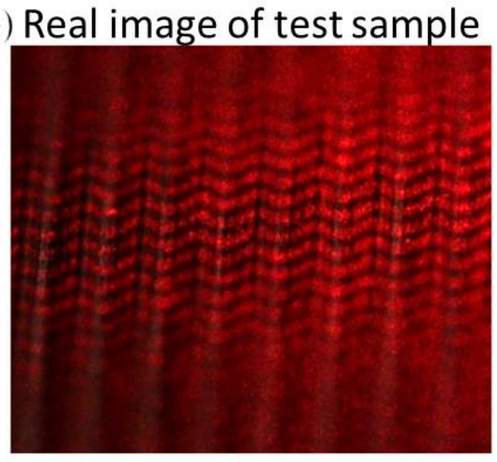


Simulation

a) NSQ Simulation with Zemax



b) Real image of test sample



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