Department of Physics
Umeå University December 5, 2017

Crack Detection using Inductive Methods

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December 5, 2017

Abstract

Non-invasive measurement techniques / v1.0
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1 Introduction

2 Theory

$$\mathrm{OPD} = 2\mathrm{OPL}_{L_2} - 2\mathrm{OPL}_{L_1} = 2nd + \mathrm{const.} \tag{1}$$

where OPL is the optical path length

$$\mathrm{OPD} = N\lambda \tag{2}$$

where N is the number of interference fringes and λ is the wavelength of the light. Putting this into Eq. (1) yields

$$N\lambda = 2nd + \mathrm{const.}.$$

Instead of counting the absolute number of fringes one can count the number of fringes that appear when changing the refractive index of the sample, namely by increasing the pressure from vacuum then

$$\Delta N\lambda = 2d\Delta n = 2d\alpha\frac{\Delta P}{P_0},$$

where P is the absolute pressure,P_0 is the pressure according to STP conditions and α

3 Experimental setup

The experimental setup used to measure the index of refraction for various gases is illustrated in Fig. 1.

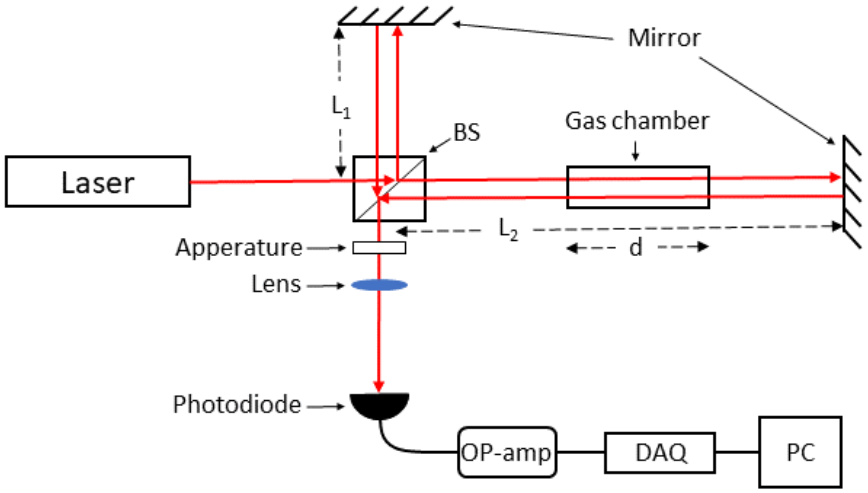


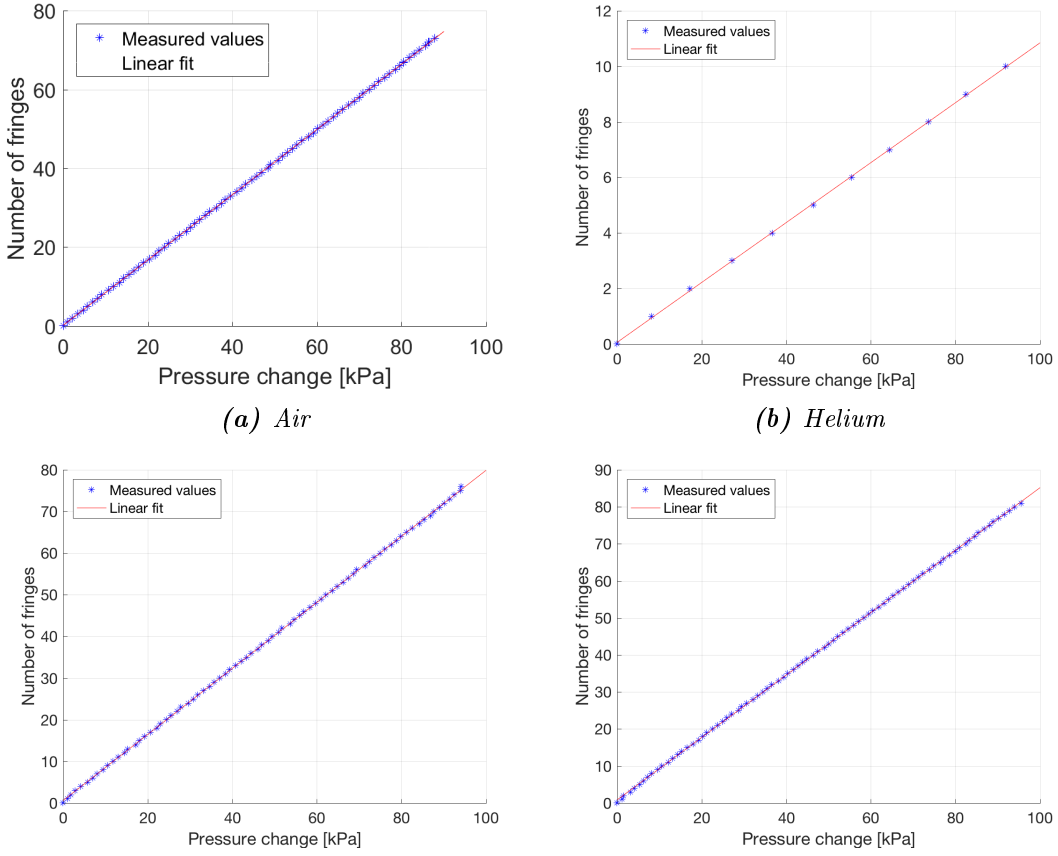
Figure 1 *– Experimental setup.*

4 Results and discussion

The number of fringes was plotted against the pressure change for the different gases and is found in Fig. 2. As one can see in the figures all gases showed a linear relation which was expected. When comparing Fig. 2b with the others the number of fringes is a lot lower than for the others. This means that the index of refraction must be a lot lower for this and the relative error will probably be larger.

Table 1 – *Fitting parameters for the measured values in Fig. 2. Linear fit on the form* $y = \alpha x + \beta$.

	α	β
Air	0.828(1) kPa^{-1}	0.16(6)
Helium	0.108(1) kPa^{-1}	0.06(5)
Argon	0.793(1) kPa^{-1}	0.61(5)
Nitrogen	0.843(1) kPa^{-1}	0.86(5)



(a) *Air* ***(b)*** *Helium*

(c) *Argon* ***(d)*** *Nitrogen*

Figure 2 – *Number of fringes and pressure change for the different gases with linear fits. Fitting parameters are found in Tab. 1*