



POLITECNICO DI TORINO
Repository ISTITUZIONALE

Acoustic Thermometry Based on Accurate Measurements of Speed of Sound in Air

Original

Acoustic Thermometry Based on Accurate Measurements of Speed of Sound in Air / Thirumalai Raj, Srijith Bangaru. - (2021 Oct 22), pp. 1-97.

Availability:

This version is available at: 11583/2934680 since: 2021-10-27T13:09:20Z

Publisher:

Politecnico di Torino

Published

DOI:

Terms of use:

Altro tipo di accesso

This article is made available under terms and conditions as specified in the corresponding bibliographic description in the repository

Publisher copyright

(Article begins on next page)

Summary

Accurate measurements at large distances in air are carried out using laser interferometers. The air-refractive index of the medium in which the measurement is carried out is the limiting factor for the measurement accuracy. In turn, air temperature is the key measurement to be performed. In order to achieve an uncertainty of 10^{-7} in large distance measurements, the uncertainty of temperature measurements over the whole optical path shouldn't exceed 0.1 °C. This level of accuracy is required in the field of manufacturing processes of large structures in particular aerospace industries and windmill blades.

To achieve this level of accurate temperature measurements an acoustic thermometer experimental set-up is presented in the first part of the thesis. The thermometer has demonstrated a resolution of the order of 0.1 °C, over a distance of 11 m. The temperature is inferred from the measurement of the speed of sound through the inversion of the Cramer formula which allows to calculate the speed of sound from temperature. The intrinsic accuracy of this formula is 300 ppm and this is the main limit to the accuracy of the thermometer.

In the second part of the thesis, an experiment to measure the speed of sound in a selected set of environment conditions has been carried out. The uncertainty of the results is within 100 ppm allowing to improve the knowledge of the speed of sound with respect to the Cramer equation by a factor three.