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.