Application de l'holographie numérique deux couleurs à la caractérisation 3D de gouttelettes micrométriques produites par la rupture d'un filament viscoélastique

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Abstract

This thesis investigates the properties and behavior under stress of a class of non-Newtonian fluids known as viscoelastic fluids. These fluids are composed of high-molar-mass molecules, giving them both viscous and elastic characteristics. Their extensional deformation reveals complex dynamics, such as the formation of the "beads-ona- string" structure. A specific application of this study focuses on the multiple interactions between expiratory events and saliva particles within a human oral cavity. These interactions can lead to the formation of bead-on-string structures and result in the ejection of viscoelastic particles, in various forms, out of the oral cavity. To model and study these interactions, an experimental setup was designed. This setup simulates the double stretching of viscoelastic fluids prepared from polyethylene oxide in a controlled environment. It allows for statistical studies on the extensional properties of the fluid, as well as the exploration of the disruption of viscoelastic fluid particles by an air flow. The high repeatability of the experiment enabled tracking of particle movements with high temporal resolution. Furthermore, the nature of the fluid particle deformations necessitates the use of three-dimensional imaging methods. To this end, a digital holography setup was developed and calibrated. Particular attention was paid to characterizing the holography system to avoid measurement biases during the localization and description of objects. Additionally, an innovative method for detecting the focal plane was developed. Based on the phase distribution of the complex amplitude, this method enhances the accuracy of 3D object localization.