

Preface

Careful and continuous detection of velocity and changes in temperature over a distributed region is required in quite a few contexts. Using appropriate light sources, it is possible to map velocity and temperature fields over a cross-section and as a function of time. If the region of interest is transparent, refractive index would be a field variable and beam bending effects can be used to extract information about temperature. Similar principles can be used to determine concentration of salts dissolved in liquids. Time-lapsed images of light intensity can also be used to determine fluid velocity. The fundamentals involved in such measurements, experimental setup, and data analyses constitute the scope of the monograph.

Over the past three decades, laser measurement techniques have become popular, though primarily as a flow visualization tool. Literature in the past decade, however, has emphasized the possibility of quantitative measurements. Optical imaging can be carried out using transmitted light in transparent media or scattered light from particles carried by the flow. Optical methods that utilize the dependence of refractive index of light on density (and indirectly on concentration and temperature) can be configured in many different ways. Three available routes considered are interferometry, schlieren, and shadowgraph. Images recorded in these configurations can be analyzed to yield time sequences of 3D distributions of the transported variables.

Optical methods are non-intrusive, inertia free, and can image cross-sections of the experimental apparatus. With the experiment suitably carried out, 3D physical domains with unsteady processes can be accommodated. Thus, optical methods promise to breach the holy grail of measurements by extracting unsteady 3D data in applications related to transport phenomena. The monograph is intended to provide the readers a glimpse of this exciting development.

A companion volume by the authors entitled *Imaging Heat and Mass Transfer Processes—Visualization and Analysis* is concerned with refractive index-based imaging in a variety of applications.

Pradipta K. Panigrahi
Krishnamurthy Muralidhar

Schlieren and Shadowgraph Methods in Heat and Mass
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Panigrahi, P.K.; krishnamurthy, m.

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