**Thermographic Particle Velocimetry (TPV): An Experimental Technique for Simultaneous Interfacial Temperature and Velocity Measurements Using an Infrared Thermograph**

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**HIGHLIGHTS**

- An IR imaging technique, termed thermographic particle velocimetry (TPV), was developed for the investigation of multiphase flows
- 2-D liquid-surface temperature and velocity measurements are recovered simultaneously
- Image processing steps are demonstrated in a heated and stirred flow
- Validation experiments are presented for the interfacial temperature and velocity

**ABSTRACT**

We present a novel experimental measurement technique, which we refer to as “thermographic particle velocimetry” (TPV), and which is capable of recovering two-dimensional (2-D) surface temperature and velocity measurements at the common interface of multiphase flows by employment of a single IR imager. The technique exploits the emissivity disparity (in the IR) between the fluid and highly-reflective particles; when suspended near or at the interface, the particles are distinguished from the surrounding fluid due to their differing emissivity without the need for a light source (laser or flash-lamp). The processing steps necessary in order to recover accurate temperature and velocity data from raw IR images, such as the decomposition of raw images into thermal and particle images, the application of filtering operations, perspective distortion corrections and spatial calibrations, and finally the implementation of standard PIV algorithms, are demonstrated by application of the proposed TPV methodology in a heated and stirred flow in an open container. The efficacy of TPV in recovering 2-D surface temperature and velocity data is examined by carrying out dedicated validation experiments. The obtained deviations between the results generated using conventional techniques and those from TPV do not exceed the errors associated with the former. The proposed technique is also demonstrated by simultaneously recovering temperature and velocity data from the gas-liquid interface of wavy film-flows downstream of a localized heater.

![Image](image_url)

**Fig. 1** Interfacial temperature (left), and combined temperature and velocity measurements generated using PIV (middle) and PTV (right), at the gas-liquid interface of a particle-laden, heated and stirred water-flow.