Optical tomography: principle, techniques, and applications

Synopsis:

The realization of multiple phases flow visualization using capacitance sensors together with process tomography technique has shown improvements in process control as well as the process output. In this book, the study has concentrated on the design and experimental implementation of optical sensors as an alternative solution to the visualization of solid/gas flow system. The design has employed 16 LEDs to generate fan beam projection and 16 PIN photodiodes to retrieve the imformation from each projection. A switch mode projection controller is designed to control the projection and interrogate the maximum number of measurements from optical sensors. This configuration utilized the divergent–beam interrogation where a larger angle of divergence provides better measurements. The transient respsonse of sensor is investigated to maximize the data acquisition rate. As a result, the maximum data acquisition rate achieved was 529 fps where each frame consisted of 256 measurements. Modeling of projection area based on sensors geometry position and covering direction is carried out to produce the sensitivity map for each pair of sensors. Then, the sensors output modeling is performed to predict the projection area modeling. A new type of back projection algorithm named graphical back projection (GBP) has been developed based on a retrieved computer graphic memory principle to produce a higher performance of image reconstruction. The comparison of image reconstruction algorithms has shown that result produced by GBP is similar to the Linear Back Projection in terms of quality but 2.1 times faster in resolution 32 × 32 and 13.3 times faster in resolution 128 × 128 in terms of performance. Experimental results obtained off–line using idealized flow models and on–line using a solid particles flow demonstrate the performance of the system and highlight areas where further development is needed.

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