



Institute of Paper Science and Technology

Technology Transfer Fact Sheet

Diagnostics for Single and Multilayer Forming Profiles

REAL-TIME MEASUREMENT OF JET SURFACE VELOCITIES IMPROVE UNIFORMITY

The ability to accurately measure the jet velocity profile in the forming section of a paper machine is critical to the control of the physical properties of the finished sheet or board – namely, the basis weight, fiber orientation, and uniformity. A major contributor to nonuniformity is small-scale and large-scale differences in fiber orientation and basis weight in both the MD and the CD.

A technique to directly measure the local velocity variations over both space and time is required for real-time control of sheet properties. IPST's new high-speed imaging technology application, known as the *Surface Pattern Image Velocimeter*, or *SPIV*, is an on-line diagnostic tool that allows mill personnel to investigate and optimize the forming section process and to improve product uniformity. The tool can accurately monitor and diagnose jet quality problems in commercial headbox flows by measuring surface jet velocities (see Figure 1).

To date, control of the jet velocity to obtain the desired jet-to-wire ratio has typically been accomplished using feedback from a sensor that measures pressure at a single location inside the headbox. The

velocity profile of the jet is not necessarily uniform nor constant over time, however.

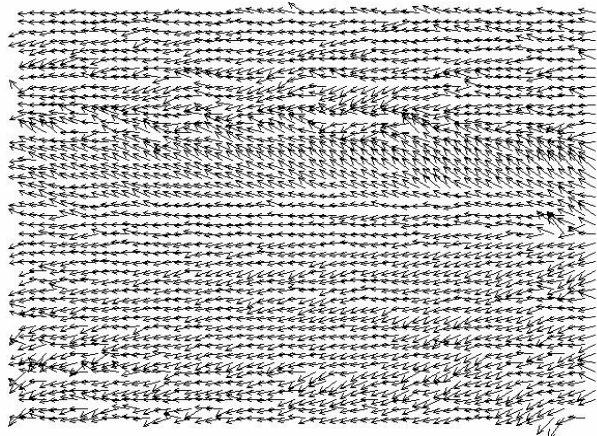


Figure 1. Velocity field of the full imaged area output by the Surface Pattern Image Velocimeter (SPIV).

The SPIV is a product of IPST's Fluid Dynamics and Forming Unit. Basically, the SPIV software and hardware processes static pairs of digital images to calculate the full velocity field vector across the image frame (see Figure 2) and then calculate mean velocities along constant lines and across the full frame. The SPIV discretely processes a sequence of images to calculate the time dependence of the velocity at a designated point in select image frames. Other features include spectral and root-mean-square analysis.

Project Description

Experts in IPST's Fluid Dynamics and Forming Unit will train and support personnel at your facility to use the Surface Pattern Image Velocimeter. Software is available at your request, as is loan of the equipment required. The option to buy instrumentation for your facility can be explored with IPST's assistance.

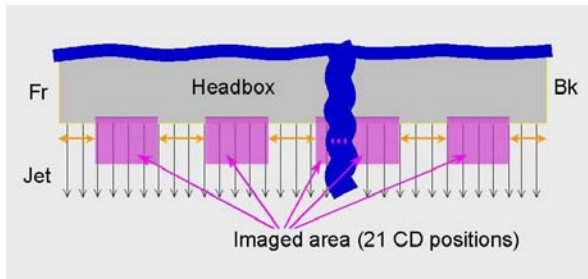


Figure 2. Imaged area of the primary headbox in a two-layer linerboard production.

The proprietary software works in conjunction with a high-speed digital video camera shooting typically at 1,000 frames per second. Images are transferred to the core memory of a motion analyzer. The software runs on a Windows-based notebook computer (see Figure 3).

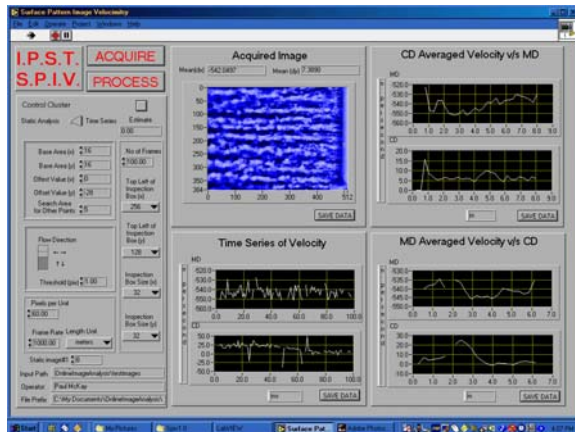


Figure 3. User interface for the SPIV proprietary software.

Benefits

Use of SPIV can improve MD and CD uniformity and reduce over-utilization of fiber and other raw materials by decreasing variation in basis weight and moisture with a net increase in profitability for the mill. A \$0.5 million return can be expected for every 1% increase in overall machine efficiency due to reduced off-grade.

Applications

The SPIV documents the jet velocity profile over the entire imaged area of a paper machine forming section. Proprietary software is available to member company facilities with no royalty fee.

Progress and Milestones

As of May 2001, three commercial machines have been optimized using SPIV technology.

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