2002 BELTWIDE COTTON CONFERENCES, ATLANTA, GA – JANUARY 8-12

COTTON FLOW CONTROL SYSTEM FOR MODULE FEEDER

Mike Gvili
Agriplan Inc.
Stow, MA

Abstract

This paper describes the design and implementation of a Cotton flow monitoring and control system for cotton gins. The system comprises of new flow sensors utilizing electro-optic technology. They combine emitters and detectors mounted on the air pipe of the gin, pass the module feeder. As the cotton passes through, it is illuminated by the emitters. The detectors which are positioned across the chute detect the light pulses. The pulse count is relative to the volume and density of the cotton. They are used to estimate the mass of the cotton passing through the air pipe. These continuous measurements are transmitted to a control unit which calculates a correction signal for the feed motors of the module feeder. This system, in a closed loop operation is capable of compensating, for variation in feed conditions. The speed of the module feeder is adjusted is compensated for module highs, density, gaps between modules and even overcome clogging due to module collapse and feed of slugs.

Introduction

The flow of cotton into the gin is currently controlled by motors which drive the cotton from the module feeder. Many gins also utilize a flow control mechanism, which is installed pass the module feeder, to control the flow of cotton by feeding it at constant rate, set by the ginner. Both methods are deployed in an open loop. The do not have a flow monitoring device to determine if the flow is matched to the gin capacity. The ginner provides that input as he/she monitors the condition of the gin and make the adjustment to the motor speed, using motor speed control devices (drivers).

Several instruments have been attempted to estimate the flow of cotton in an air pipe with varying degrees of success. Optical, sound, impact and pressure transducers were proposed and tested [1,2].

The system described here makes use of IR emitters and detectors to calculate the mass of cotton in an air stream. The sensor technique has been in use with cotton picking machinery[3]. There the sensors was mounted in the chutes of the picker, and monitored yield which was calculated as the flow per unit of harvest area. At the gin the sensors, with similar structure and design, were mounted on the pipe feeding the cotton into the gin, from the module feeder.

System Description and Operation

The Flow Control System consists of Main Processing Computer (CPU), a display device, a pair of sensors and interconnecting hardware. the sensors (emitters and detectors) are mounted across the air flow pipe (fig.3). During the process time the flow of cotton through the pipe is estimated and a correction signal is sent to motor drive to slow-down or speed-up the module feeder feeding rate. The control algorithm was chosen to be a PID control where the coefficients were adjusted per the actual gin performance for best system response.

Sensor Design and Operation

The sensor is composed of Infra Red (IR) emitters, detectors, signal conditioning and processing units. The emitters are built of IR lamps which are driven by pulsing driver circuits. The sensors components are enclosed in weather sealed enclosures which are mounted on the surface of the pipe. Openings are drilled on the pipe to accommodate the sensors. Electrical cables connect the sensors assemblies to the CPU in the control panel. The emitters illuminate the chute. As cotton passes through the chute it blocks the IR light from reaching across to the detectors. The light blockage provides information about the size (volume) of the cotton passing through. The signals from all the detectors is being filtered, amplified and converted into digital format for further processing by the sensor's on board processor. The resulting measure of seed cotton mass is transmitted through the system bus to the CPU.

Test and Results

The throughput of an operating gin was recorded during the ten day interval before the deployment of the system, and then during the ten days following the deployment. The results are presented in Table 1 and Figure 2. A measurable improvement in capacity can be observed.

It is sufficient to say that additional test must be performed in order to quantify the capacity benefits of the system in terms of the improvement in throughput, reduction of clogging and flow related interferences and is affect on overall gin performance.

References

1 G. L. Barker et al, Comparison of mass flow rate sensors for ginning stripper harvested cotton. 1999 ASAE.

2 P.A. Funk et al Mass Flow Measurement of Seed Cotton; 2000 ASAE.

Mike Gvili, Jerry Brightbill, Stripper Cotton Yield Sensor Produces Yield Map ; Beltwide 2001

J.A. Thomasson et. al. 1997.Mass Flow Measurement Of Pneumatically Conveyed Cotton. Proceedings Beltwide Cotton Conference 1997.

Table 1: Production Data; Daily output in bales during ten days before deployment vs. ten days after deployment.

Measured daily throughput (Bales per day)	
Before Deployment	**After Deployment**
492	493
513	463
461	537
518	491
503	495
436	475
465	538
502	493
430	525
481	502

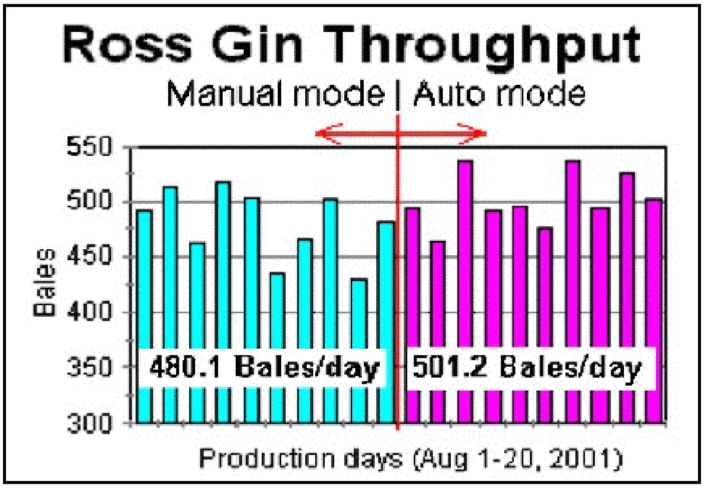

Figure 1. Gin throughput before and after deployment of the flow control system.

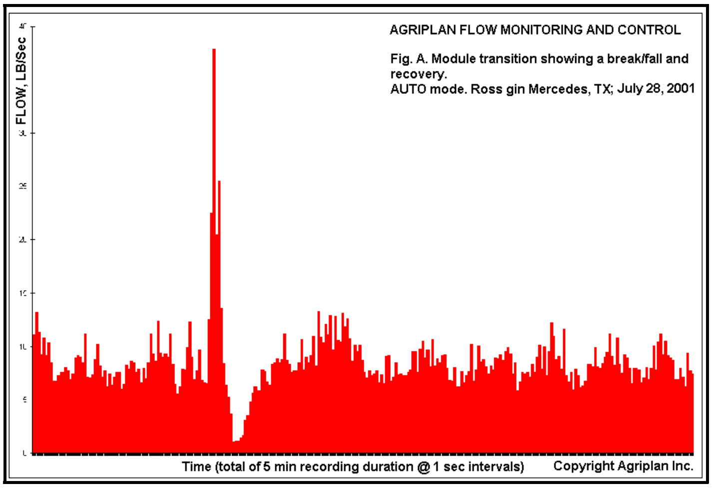

Figure 2. Recorded flow during module collapse and recovery with the control system deployed.

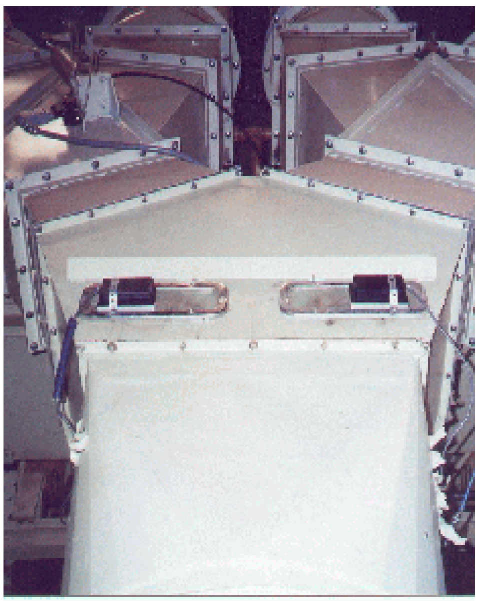

Figure 3. Installed sensor pair on a feed pipe in a California cotton gin.