# APPLICATIONS OF USTER® INTELLIGIN

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## Abstract

The concept of gin process control with reference to it's history and benefits to growers is reviewed. This concept is put into practice in the form of Uster® IntelliGin, which was introduced in the market in 1997. The principles of operation and new designs were verified at three installations in this year. The results and the values to the grower, ginner, and the spinner are analyzed.

## Introduction

In the previous papers published the ginning process (Table 1) was reviewed and an eye-opening account of the influence of fiber moisture and various machineries on the properties of cotton fibers was given. This paper describes the fundamentals of IntelliGin, a gin process control system designed to optimize the ginning process. IntelliGin's application in the 1997 ginning season and the impact that this product is expected to have on the cotton industry is also reviewed.

The concept of gin process control is to monitor fiber properties at strategic points in the ginning process and based on the results automatically control or instruct the ginner to change the process for the most efficient ginning results. The work on this idea started about 10 years ago and Mr. Stanley Anthony and the staff at the USDA, ARS Ginning Laboratory at Stoneville, Mississippi are credited for making this idea a reality today.

In 1996, Zellweger Uster licensed the associated technologies from the USDA and using the latest developments in fiber testing redesigned the system and introduced the IntelliGin to the market at the 1997 Beltwide.

## Discussion

The features of IntelliGin can be summarized as:

- Real time measurements of fiber color, trash, and moisture
- Control of dryer's temperature for optimum fiber moisture
- Control of seed and lint cotton by-pass valves
- Off-line micronaire measurement for classification & warehousing

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IntelliGin, in real time, measures fiber moisture, color, and trash on-line at three strategic ginning points; module feeder, after gin stand, and after lint cleaners. With this information on the fiber properties, as well as the pricing structure of the cotton, the dryer's temperatures are automatically adjusted for the optimum fiber moisture and the optimum number of cleaning equipment is selected for the maximum lint turnout.

Figure 1 shows the control console of the IntelliGin and Figure 2 is a typical screen displaying an overview of the full operation. The three monitoring stations are numbered and their positions are shown as a cross-sectional view of this gin's layout, which consists of a module feeder, 2 dryers, 2 stick and 2 impact seed cotton cleaners, 3 gin stands, 3 three-stage lint cleaners, and the bale press.

The status of the gin's operation for each machine, as well as the dryer's temperatures, are continuously displayed. Based on the moisture, color, and trash data, as well as cotton price structure, IntelliGin will optimize the grower's profits by selecting the appropriate drying temperature and using by-pass valves routes the cotton flow through the optimum number of seed and lint cotton cleaners. This information, along with digitized pictures of the cotton sample under evaluation, are displayed. The ginner can review the final data for each bale, which includes bale weight, grade, micronaire, trash moisture Rd, and +b in real time as the bales are rolled out of the press.

On-line fiber testing instruments in the gins face operational environments with large changes in ambient conditions, dust and lint accumulations, vibrations of the structures that the sensors are mounted on, and finally the automated on–the-fly sample handling make the task far more challenging than their off-line counter parts. The designs must be robust and the need for calibration of the sensors must be minimum.

Figures 3 and 4 show a typical monitoring station. The required inputs are power and compressed air for sampler hand operation. The test data, including the digitized images are transmitted to the host computer using radio frequency transmission eliminating the need for cabling through the gin. A xenon bulb flasher is used as the light source for the trash camera and the color sensors. This replaces the current incandescent lamps, which are prone to changes in intensity due to aging and vibrations. This approach dramatically increases the calibration stability and reduces it's frequencies. The color and trash window and moisture sensor are located side-by-side. The sampler hand up to 10 times per minute, rotates, catches cotton from the duct and compresses it against the color and trash window and the moisture sensor which are located side-by-side. Due to the possibility of moisture variation across the width of a module, two stations are used at the module feeder. Figure 5 shows the structure of the by-pass valves that route the cotton through selected stages of lint cleaners. And finally, an off-line micronaire testing station is located after the bale press (Figure 6). The operator tests for micronaire, which combined with the color and trash data allows the ginner to categorize the cotton for the direct shipment to the mills from the warehouse.

So what makes this product different from standard fiber testing instruments and why is the industry excited about its introduction?

The unique application of this product creates a four-way winning scenario for the grower, the ginner, the spinner, and the cotton industry as follows:

| | | |
|---|---|---|
| Grower | ➜ | More value through higher turnout |
| Ginner | ➜ | Higher fees, improved efficiencies and other options |
| Spinner | ➜ | Higher fiber qualities |
| Industry | ➜ | Bridge gap between growers and spinners |

To illustrate the benefits to a grower, an outline of the operation at a typical gin for strict low middling cotton which has a value of 52.45 cents per pound according to 1997 CCC loan tables, is used:

Operation at Typical Gin

| Process | Setup |
|---|---|
| Module moisture | 9% |
| Three Seed Cotton Cleaners | |
| Dryer Temperature | 200 F° |
| Two Lint Cleaners | |
| Cotton Moisture | < 3% |
| Grade | 31-3 |

The decision-making process used by IntelliGin, examines the CCC loan value table for strict low middling cotton as shown in Table 2. The staple 34 and leaf grade 4, in the center, is the base price for the cotton. It should be noted that the price is the same for leaf grade 1 through 4. By analyzing the values for moisture, color and trash at the 3 monitoring stations, IntelliGin reduces the dryer temperature to 100 degrees and re-routes the cotton such that one seed and one lint cleaner are by-passed. The results are an increase of the turnout by a total of 27.5 pounds, reduction of grade from 31-1 to 41-4 and a net gain of $13.25 per bale as follows:

Operations at Gin Equipped with IntelliGin

| Process | Setup | Gains(lb) | Gains($) | Loss ($) |
|---|---|---|---|---|
| Module Moisture | 9% | - | - | - |
| Two Seed Cleaner | - | 5.0 | 3.5 | - |
| Dryer Temperature | 100F° | - | - | - |
| Cotton Moisture | 5.5% | 12.5 | 8.75 | - |
| One Lint Cleaner | - | 10.0 | 7.00 | - |
| Grade | 41-4 | - | - | 6.00 |
| Net Gains = $13.25/bale | | | $19.25 | 6.00 |

The ginner is a winner due to increased marketability of his services as well as higher efficiencies in the operation. The fiber information which includes off-line micronaire, allows for categorization of cotton at the warehouse.

In 1997 IntelliGin was installed at the following gins:

- Servico Gin, Decatur, Alabama
- McClendon, Mann & Felton Gin Co., Inc., Marianna, Arkansas
- Dumas Cotton Gin, LLC, Dumas, Arkansas

The fiber quality data from Servico Gin is used to illustrate the benefits of such a system to the spinner.

Tables 3 through 7 display fiber characteristics such as HVI length, length uniformity, and strength along with AFIS neps, seed coat neps, trash, visible foreign matter and short fiber content for the Birmingham Classing Office, Visalia Classing Office, and Servico Gin. The improvements in all of the fiber qualities, and in turn the benefits to the spinner are significant.

And finally the textile industry is a winner. Off-line fiber testing is, for all practical purposes, a reactive process which measures fiber qualities but cannot alter them. Whereas on-line fiber testing at the very beginning stages of fiber processing, i.e. de-linting of fibers from the cotton seed, is a proactive process, which can positively influence fiber qualities.

Ginning practices in this country are often questioned and criticized. The statistics in Figures 7 through 9 illustrate the reason behind the ginning practices.

Figure 7 shows 1996 cotton crop for color grades 11 and 21 with their leaf grade distribution. These color grades made up 18.2% of the total U.S. crop with the leaf grades of 1 through 3 totaling to 17.6%. It should be noted that the CCC loan value differential between leaf 1 and 7 is 1055 points translating to more than 10.5 cents per pound in price for the grower.

Figure 8 shows the same information about color grade 31 totaling to 37.5% of the crop with the price differential of 10.5 cents per pound for the extreme leaf grades.

Figure 9 shows the same information on color grade 41 totaling to 19.3% of the crop with the price differential of more than 10.1 cents per pound across the range of the leaf grades.

To sum up these statistics, seventy five percent of U.S. cotton crops in 1996 were grades 11, 21, 31 and 41 and (11.8 +5.8 +11.8 +20.2 +2.5 +12.1) 64.2 percent of the U.S. crop were leaf grades 1, 2, and 3. With the penalties associated with the lower leaf grades, the incentives for the grower and the objectives of ginner are clear.

As it has been mentioned, IntelliGin allows a grower to maximize his profits through the optimization of the final grade and the lint turnout under the current pricing guidelines. The improvements noted in fiber qualities are strictly a by-product of this process and not the primary objective for the grower.

The full potential of IntelliGin is realized through a change in the current cotton marketing system by creating incentives to reward the grower for better fiber qualities. Such system must respond to the needs of the users of cottons, and modify the current pricing structure of the cotton such that the fiber qualities of interest to the end user are emphasized and expanded to include such important properties as length uniformity, short fiber index and fiber neps. To make this happen, it is the spinners who will have to initiate the process by placing values on fiber properties that are deemed crucial to their operation. This important step, at least on a one-on-one basis, has been taken by a few in the form of the gin direct program with success.

And finally, it should be mentioned that there is a fifth winner. As technologists, it is very gratifying to be instrumental in developing products that have positive impact on the industry. HVI was an example of such a project. We feel confident that IntelliGin has the promise of yet another significant product for the textile industry. This product will serve the interests of the supplier and the consumer of cotton, therefore bridging the gap that seemingly has been around for a long time.

Table 1. Ginning Process.

. Drying cycle (up to 2 stages)
. Trash removal from seed cotton (up to 4 stages)
. Lint-seed separation
. Trash removal from lint (up to 3 stages)
. Bale packaging

Table 2. 1997 CCC Loan Values.

| Leaf Grade | | | Staple | | | |
|---|---|---|---|---|---|---|
| Color | 32 | 33 | 34 | 35 | 36 | 37+ |
| SLM 41 | 1 inch | 1-1/16 | 1-1/16 | 1-3/32 | 1-1/8 | 1-5/32 |
| 1-2 49.05 | 50.75 | 52.45 | 53.00 | 53.05 | 53.05 | |
| 3 49.05 | 50.75 | 52.45 | 53.00 | 53.05 | 53.05 | |
| 4 48.90 | 50.65 | 52.45 | 53.00 | 53.05 | 53.05 | |
| 5 47.05 | 48.55 | 48.90 | 49.35 | 49.35 | 49.40 | |
| 6 44.75 | 46.25 | 46.25 | 46.25 | 46.25 | 46.25 | |

Table 3. IntelliGin Results 1997 for HVI Length.

| | <34 | 35-36 | >37 | Average |
|---|---|---|---|---|
| Birmingham CO | 24 | 58 | 18 | 35.4 |
| Servico Gin | 1 | 29 | 70 | 36.6 |
| Visalia CO | 1 | 53 | 46 | 36.3 |

% of Total Bales Measured

Table 4. IntelliGin Results 1997 for HVI Uniformity.

| | 77-79 | 80-82 | 83-85 | Average |
|---|---|---|---|---|
| Birmingham CO | 9 | 77 | 14 | 81.2 |
| Servico Gin | 1 | 44 | 55 | 82.5 |
| Visalia CO | 0 | 62 | 38 | 82.3 |

Table 5. IntelliGin Results 1997 for HVI Strength.

| | <28 | 29 | >30 | Average |
|---|---|---|---|---|
| Birmingham CO | 41 | 25 | 34 | 28.9 |
| Servico Gin | 24 | 24 | 52 | 30.0 |
| Visalia CO | 2 | 4 | 94 | 31.8 |

% of Total Bales Measured

Table 6. IntelliGin Results 1997 for Fiber Quality.

| | AFIS Data | | | |
|---|---|---|---|---|
| | Neps/g | SCN/g | Trash/g | VFM |
| Birmingham CO* | 310 | 30 | 623 | 1.65% |
| Servico Gin | 206 | 16 | 766 | 2.1% |

*Average of random samples collected from 10 different gins.

Table 7. IntelliGin Results 1997 for Fiber Quality.

| | AFIS Data | | |
|---|---|---|---|
| | L(w) | SFC(w) | UQ(w) |
| | Inch | % | Inch |
| Birmingham CO* | 0.90 | 12.4 | 1.13 |
| Servico Gin | 0.98 | 8.3 | 1.21 |

*Average of random samples collected from 10 different gins.

fig. 1

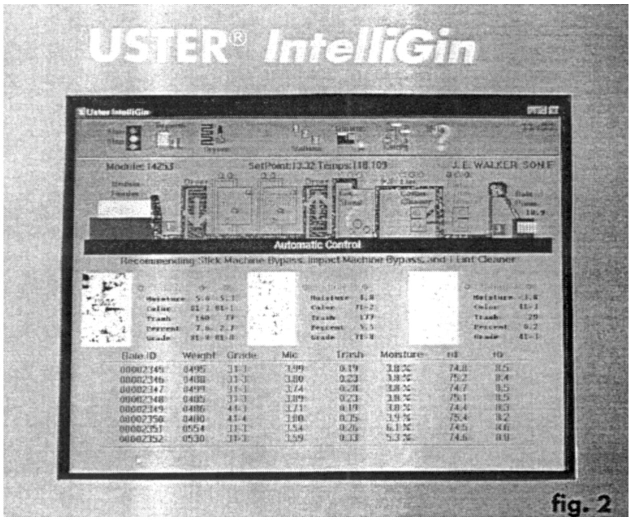
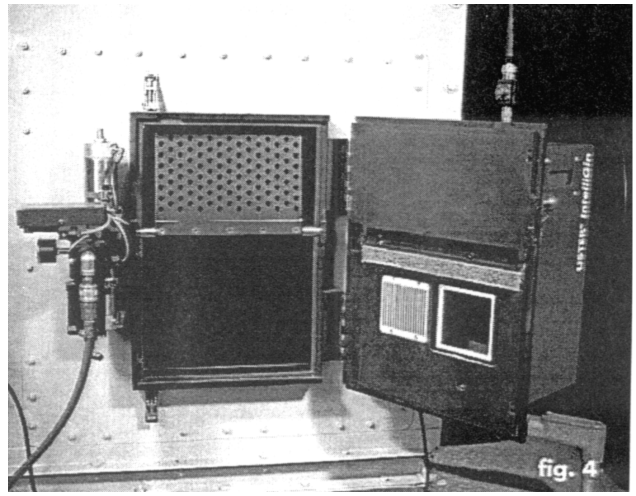



fig. 2

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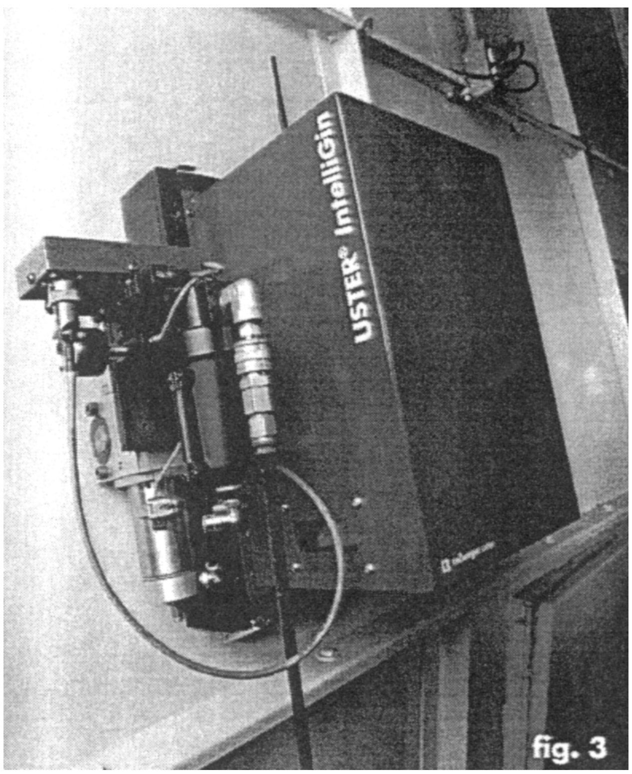


fig. 3

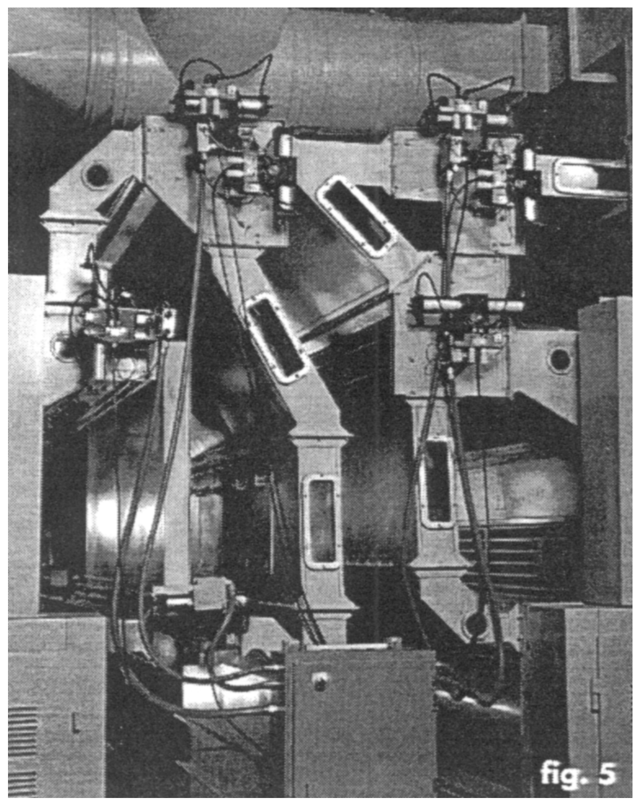

fig. 5


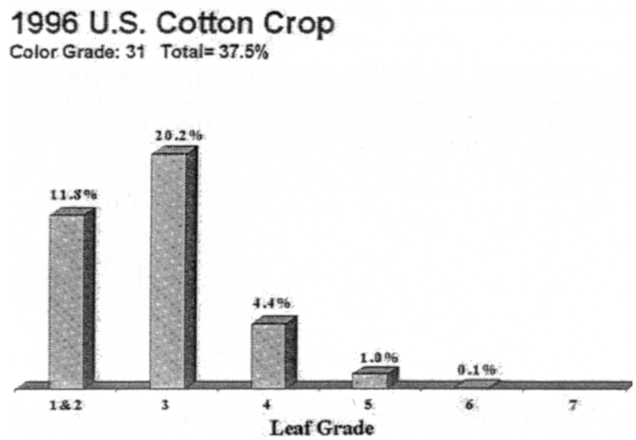


Figure 8. CCC Loan Differential Leaf 1 to 7 (Staple 35) = 1050 Points

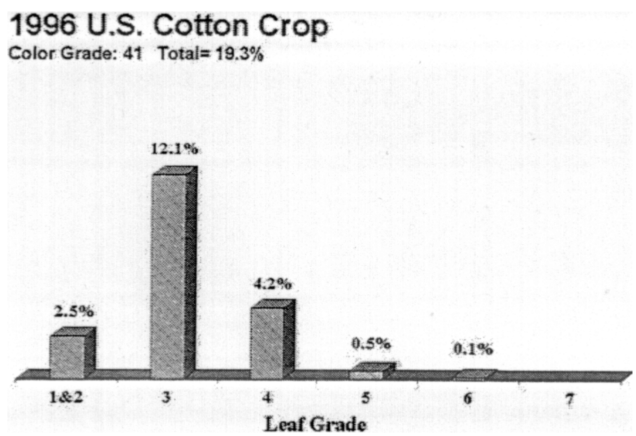


Figure 9. CCC Loan Differential Leaf 1 to 7 (Staple 35) = 1050 Points

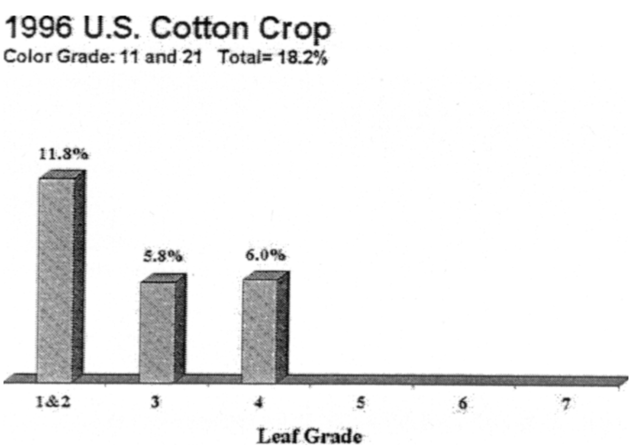


Figure 7. CCC Loan Differential Leaf 1 to 7 (Staple 35) = 1055 Points