New Automatic Inspection Technology
NxtGen™ – The Confluence of Laser and Camera Systems

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The need to improve quality and yields, while reducing manpower and scrap are constant challenges to all manufacturers. Automatic inspection systems provide the ability to inspect 100% of the web, on-line, real-time and achieve the aforementioned goals, concurrently. Historically, there have been two choices for inspection technologies; lasers and cameras. Laser systems offered technically superior performance, but at a cost which may be 2X – 4X the cost of a camera system. Camera systems provided a reasonable cost alternative, but suffered from false defect alarms and inability to detect certain types and sizes of defects, most notably scratches.

After years of development, a new inspection technology has been released, called ***NxtGen™***. ***NxtGen™*** was born from the confluence of decades of laser and camera design and applications experience, coupled with the most advanced signal processing available--marrying both the high-resolution laser system with cost-effective imaging technology. The architecture is unique; ***NxtGen™*** supports laser, camera, hybrid laser: cameras, telecentric and divergent optics and retro-reflection. This has never been done before. State-of-the-art signal processing delivers adaptive thresholding (thresholds adapt to normal product variations) and real-time convolutions (two dimensional filtering to enhance subtle defects). Each ***NxtGen™*** system control unit processes over 480 million pixels of information per second and provides defect maps, alarms and a host of additional essential features. System control units may be added to provide support for any numbers of cameras or laser scanners.

NxtGen™ delivers a level of inspection performance that has never been possible at this price. Key features include

- **100% inspection of webs and coatings**. Defects are captured on a defect map and electronically in XML or SQL files.
- **Patent pending Variable Field Scanners**. Extraordinary sub-pixel detection.
- **Patent pending optics derived from laser scanners**. Solid state design with no moving parts; **100% self aligning**.
- **Simple integration of the Windows-based data files**. Compatible with third party software, SPC packages, etc.
- **Digital outputs and alarms**. Alarms and outputs triggered for defect levels, types, repeating defects, clusters, etc.
- **Extraordinary signal processing**. Over 480 million pixels per second per system control unit.

- **Laser, camera or hybrid laser/camera optics.** System supports any combination of laser and camera optics.
- **Divergent or telecentric optics:** Conventional divergent optical systems and ever-normal telecentric optics available.

In short, ***NxtGen™*** is the most versatile system ever conceived. And, it has been designed to deliver the highest performance at the lowest cost, in the market.

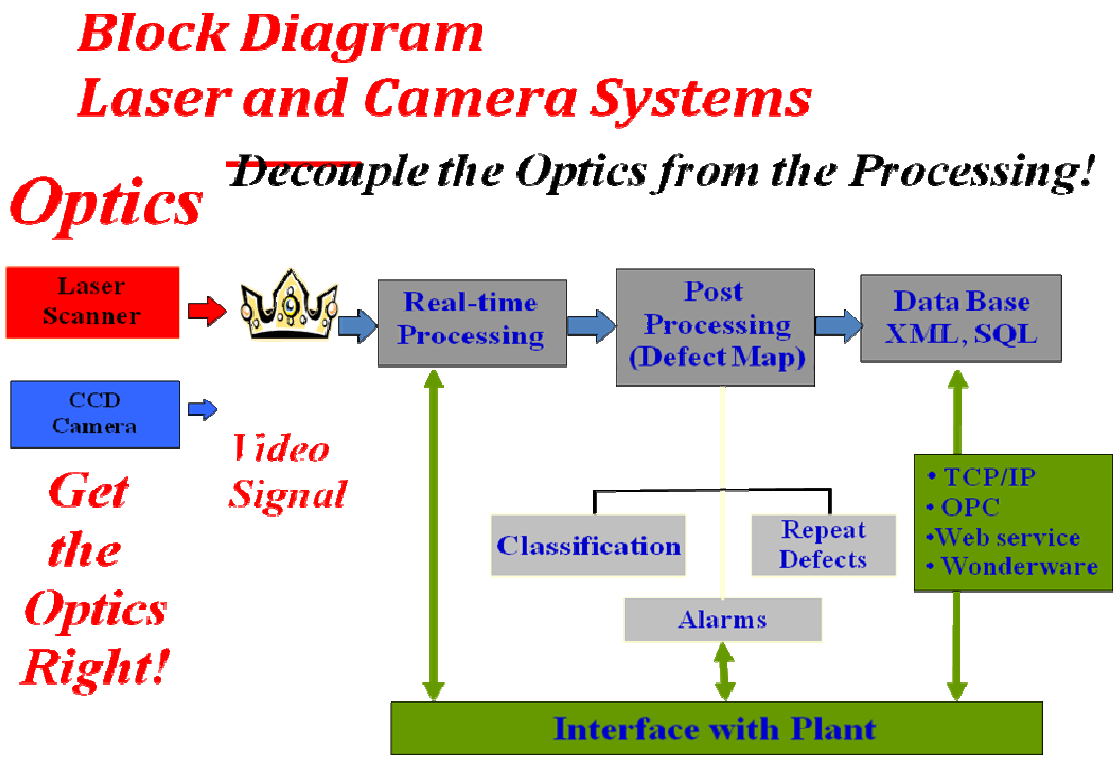
The case for Automatic Inspection

Today's driving forces include:

- Eliminate defects
- Retain key customers
- Increase throughput
- Control process
- Improve yield of highest quality product
- Reduce manpower and operating costs
- Enhance market position

Realizing the Benefits

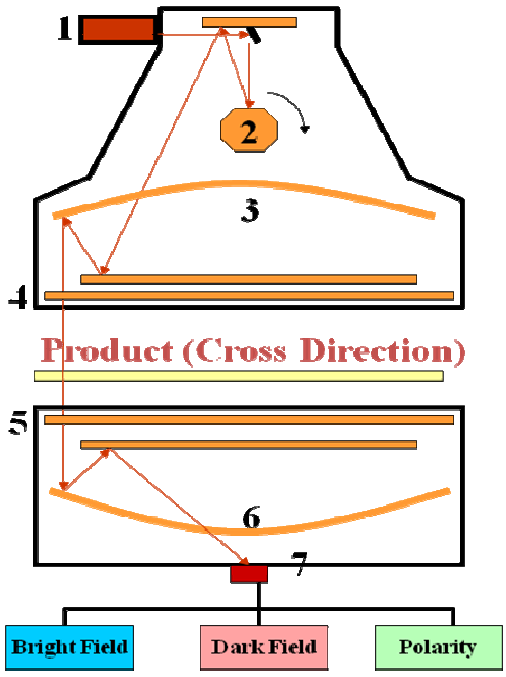
The dividing line between lasers and cameras is being obscured by ***NxtGen™***; the system has been designed to support both technologies and new Dark Field hybrid systems.



Laser System Operation

Laser Systems - Operation

1. Generate laser beam.
2. Scan, via rotating polygon
3. Normalize beam path.
4. Focus spot on product.
5. Collect and focus light.
6. Redirect scanning beam to a point of laser light.
7. PMT converts laser light energy into electronic signal.
8. Bright, dark field optical channels.



Laser systems are named for their illumination source (laser). The photomultiplier tubes (PMT's) transform the laser light into analog electronic video signals. One video signal is produced for each "optical field" of information required. For example, if a web needs to be inspected in bright field transmission and dark field reflection, this means two video signals are required (two optical channels). The design of the optics and decisions on number or types of optical fields are based on exclusion; throw away 99.999% of the web or sheet area and retain only the defects of interest. This philosophy assures a robust system which will work reliably on a production line without false defect alarms. "***Get the optics right"*** is the clarion call for inspection system designers.

Additional laser system benefits included:

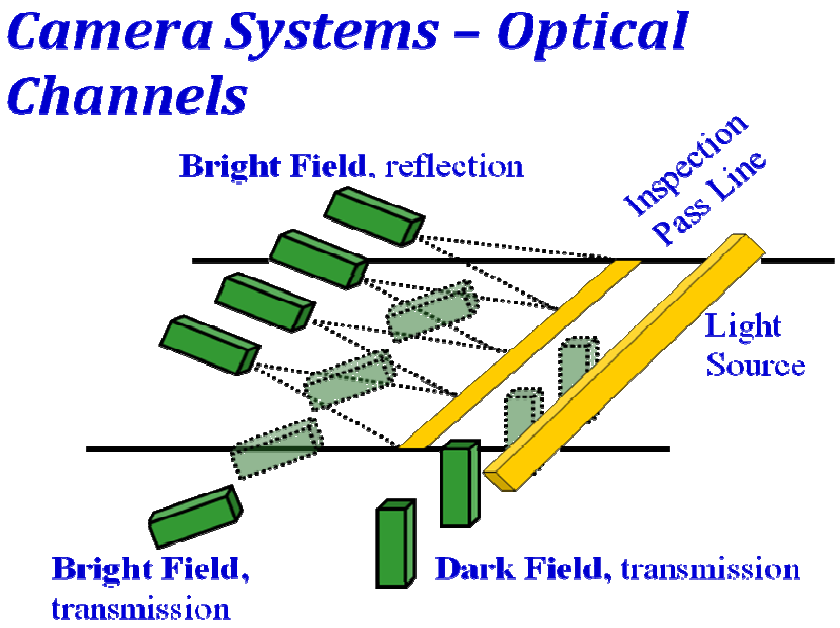
- Low power consumption.
- High energy density.
- Multiple optical channels.
- Telecentric optics.
- Self-aligning optics.

Laser system scan rates are typically limited to 6,000 scans per second, due to the limitations in the design of the scanning optical components, most notably the polygon.

PMT bandwidth, another scan rate constraint, is also expanding with advances in solid state PMT's. As lasers typically utilize a single source, this means that lasers are color blind. If color changes are important, lasers are not an elegant solution.

Until a couple of years ago, laser systems were the best technical solution to most web inspection problems. However, laser systems cost 2X to 4X more than camera systems so their market acceptance was limited to only the most demanding applications. With the advent of faster cameras, standard camera interfaces, more powerful and commercially available processing engines and LED advances, the technical convergence of cameras and lasers has taken place in the ***NxtGen™*** system architecture.

Camera Systems



Camera systems are named for their photon conversion medium; the camera serves the same function as the laser PMT. The camera silicon pixel array transforms light into digital electronic video signals. Like lasers, one video signal is produced for each "optical field" of information required.

Line scan cameras are the only reasonable choice for line scan applications, due to requisite scan rates and other optical considerations. Line scan camera rates are practically limited to 36,000 scans per second, almost 10X faster than lasers. The main limitation is illumination power. Cameras traditionally require 2X to 10X more power than a laser system and the light sources can generate a lot of heat.

Major camera advantages include:

- Low capital cost.

- High scan rates.
- Excellent practical resolution limits, i.e. 25µm.
- Solid state; no moving parts.
- Color and b/w imaging options.
- Solid state – no moving parts.
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The "Smart Camera" Problem

So called "smart" cameras were developed 10 – 15 years ago to solve the problem associated with processing limitations. At the time, there was no elegant means to transfer the data from the camera to the processing electronics. Smart cameras were developed for two reasons:

1. By packaging the processing electronics together with the camera, communication with the camera could utilize standard communication links.

2. Reduced manufacturing costs. The cameras and the associated optics, processing and software could be manufactured en masse.

Major problems have since been realized with smart camera systems.

- ♦ Fixed architecture; sub-optimal optical solutions. The camera type, array size, processing hardware and software are bundled together. There is no ability to optimize these components for an application.
- ♦ Smart cameras are not upgradeable; need to replace the camera, processing and software together. This has rendered many smart camera systems obsolete; some are only five years old!
- ♦ Obsolete architecture. Driving forces no longer exist (solved by Camera Link).

Summarizing: Lasers and Cameras

- Lasers and cameras have unique optical properties.
- The myriad of products and coatings in the web industry require optical solutions which are tailored to the application.
- An inspection system must be able to support a wide array of optical solutions – lasers and cameras; there is no "one size fits all" solution.

***NxtGen*™, Technology Confluence**

The ***NxtGen*™** system has been architected to support ALL optical solutions in both the laser and camera worlds, in addition to new optical technologies being developed by Dark

Field Technologies; the optical solutions have been decoupled from processing electronics. This means

- Selection of best optical solution; all lasers, all cameras
- Easily upgraded optics.
- Easily upgraded processing.
- Easily upgraded software.

Key architectural features include:

- Matrox hardware platform. Gold standard for signal processing engines.
- Long term upgradeability.
- Software is upward compatible with new hardware advances.
- Long term support is assured; no system obsolescence.
- 480 Mb bandwidth per System Control Unit (SCU).
- Distributed processing; can support any number of SCU's.
- 64 bit OS; removes memory constraint.

***NxtGen*™ Optical Solutions**

***NxtGen*™** systems support

- ✓ Self aligning optics: Easiest optical system in the world to install and maintain. White light and solid state laser systems.
- ✓ Flying spot laser systems (traditional laser systems): Telecentric and divergent optics.
- ✓ Solid state lasers.
- ✓ Line scan cameras: 1k, 2k, 4k, 8k, 12k and 16k.
- ✓ Black and white or color cameras.
- ✓ All illumination possibilities:
    - Diffuse
    - Concentrated
    - Structured

Summary

***NxtGen*™** systems have been designed to support all optical solutions. The systems are simple to upgrade and represent the most powerful, lowest cost inspection systems in the world.