MAINTAINING REGISTRATION OF SPATIALLY SYNCHRONIZED DATA FOR WEB PRODUCTS

TECHNICAL FIELD

The present invention relates to automated inspection of systems, and more particularly, to inspection of continuously moving webs.

BACKGROUND

Inspection systems for the analysis of moving web materials have proven critical to modern manufacturing operations. Industries as varied as metal fabrication, paper, non-wovens, and films rely on these inspection systems for both product certification and online process monitoring. One major difficulty in the industry is related to the extremely high data processing rates required to keep up with current manufacturing processes. With webs of commercially viable width and web speeds that are typically used and pixel resolution that is typically needed, data acquisition speeds of tens or even hundreds of megabytes per second are required of the inspection systems. It is a continual challenge to process images and perform accurate defect detection at these data rates.

SUMMARY

In general, techniques are described for maintaining spatial synchronization of inspection data of manufactured webs. For example, a system is described that performs spatial registration of anomaly data (e.g., defects or potential defects) collected throughout the production of a web. The techniques maintain spatial synchronization of the anomaly data even though the web may be subjected to a multi-stage converting process in which larger web rolls are converted into smaller rolls and ultimately into individual parts. The techniques may allow a saleable roll (e.g., an individual split roll) or an individual part to be traced back to the particular manufacturing conditions or quality information gathered during original manufacturing.

In one ~~embodiment~~aspect, a method comprises storing anomaly data that specifies a position of at least one anomaly within a first web relative to a set of fiducial marks on the ~~first~~ a manufactured web. The method further comprises ~~registering, with a fiducial mark reader,~~transferring the manufactured web through a conversion processing line; while transporting the manufactured web, detecting position information for the set of fiducial marks on the ~~first~~ manufactured web with a fiducial mark reader, and cutting, with a slitter positioned downweb from the fiducial mark reader, the ~~first~~ manufactured web into two or more slit rolls of web material. The method further comprises controlling a fiducial mark printer downweb from the slitter to print a set of fiducial marks on the web material of each of the slit rolls based on the position information for the set of fiducial marks on the ~~first~~ manufactured web, and maintaining spatial synchronization of the anomaly data with a position monitoring system by computing an updated position for the anomaly relative to the set of fiducial marks printed on the web material of the slit rolls.

In another ~~embodiment~~aspect, a system comprises a database that stores anomaly data acquired from a manufactured web, wherein the anomaly data specifies a position of at least one anomaly within a manufactured web relative to a set of fiducial marks on the manufactured web. The system further comprises a~~A~~ conversion processing line that comprises a fiducial mark reader to output position information for the set of fiducial marks on the manufactured web, a slitter positioned downweb from the fiducial mark reader to cut the manufactured web into two or more slit rolls of web material, and a fiducial mark printer to print a set of fiducial marks on the web material of each of the slit rolls. A position monitoring system maintains spatial synchronization of the anomaly data by computing an updated position for the anomaly relative to the set of fiducial marks printed on the web material of the slit rolls.

The details of one or more embodiments of the invention are set forth in the accompanying drawings and the description below. Other features, objects, and advantages of the invention will be apparent from the description and drawings, and from the claims.

DEFINITIONS

For purposes of the present invention, the following terms used in this application are defined as follows:

"web" means material having a fixed dimension in one direction ("crossweb direction") and either a predetermined or indeterminate length in the orthogonal direction ("downweb direction");

"defect" means an undesirable occurrence in a product;

"anomaly" or "anomalies" mean a deviation from normal product that may or may not be a defect, depending on its characteristics and severity;

"products" are the individual sheets (also referred to as component) produced from a web, e.g., a rectangular sheet of film for a cell phone display or a television screen;

"conversion" is the process of physically cutting a web into products; and

a "jumbo roll" is any roll of web material that is processed into two or more smaller rolls ("slit rolls") prior to converting to products, e.g., by cutting the web material of the jumbo roll at one or more cross-web positions.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a block diagram illustrating a global network environment in which a conversion control system controls conversion of web material.

FIG. 2 is a block diagram illustrating an exemplary embodiment of a web manufacturing plant.

FIG. 3 is a block diagram illustrating an exemplary sequence of procedures and inspections for a web.

FIG. 4 illustrates example application of fiducial marks in conjunction with an automated inspection system.