Next-Level AI based Vision Systems Papertech Vision Solutions

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Abstract:

IBS Paper Performance Group offers papermakers a suite of high-end solutions based on Papertechs' vision system technology. Their portfolio includes Web Monitoring and Inspection Systems, the iSTOP+™ non-marking winder automation solution, and the TableVision™ family for wire section optimization. Many products leverage AI for enhanced performance.

A key highlight is the AI-driven Web Inspection system, which improves sustainability and stability by accurately classifying paper defects. The patented iSTOP+™ enhances safety and reliability during unwinding without lasers or ink. AI-powered sensors like FlocVision (formation monitoring) and LineVision (dry-line monitoring) provide valuable data for machine optimization, especially when combined with adjustable foils. AI modules like CNNs are increasingly integrated into various applications, pointing towards the future of papermaking.

Keywords: *Artificial Intelligence, Web Inspection, Formation Sensor, Dryline Sensor, TableVision, FlocVision, iSTOP.*
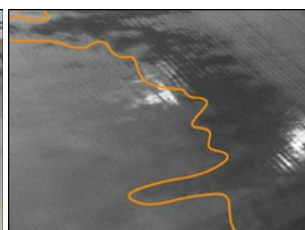
Introduction

Vision Solutions powered by Artificial Intelligence

A variety of Machine vision solutions for paper machines can be offered in the industry today, and this couldn't have been without the help of AI!
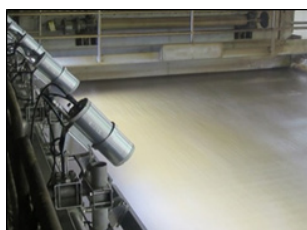
(Fig 1) Stock Activity Monitoring

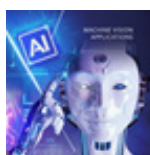*(Fig 2) Wet Line Monitoring*

(Fig 3) Jet cut-through Monitoring

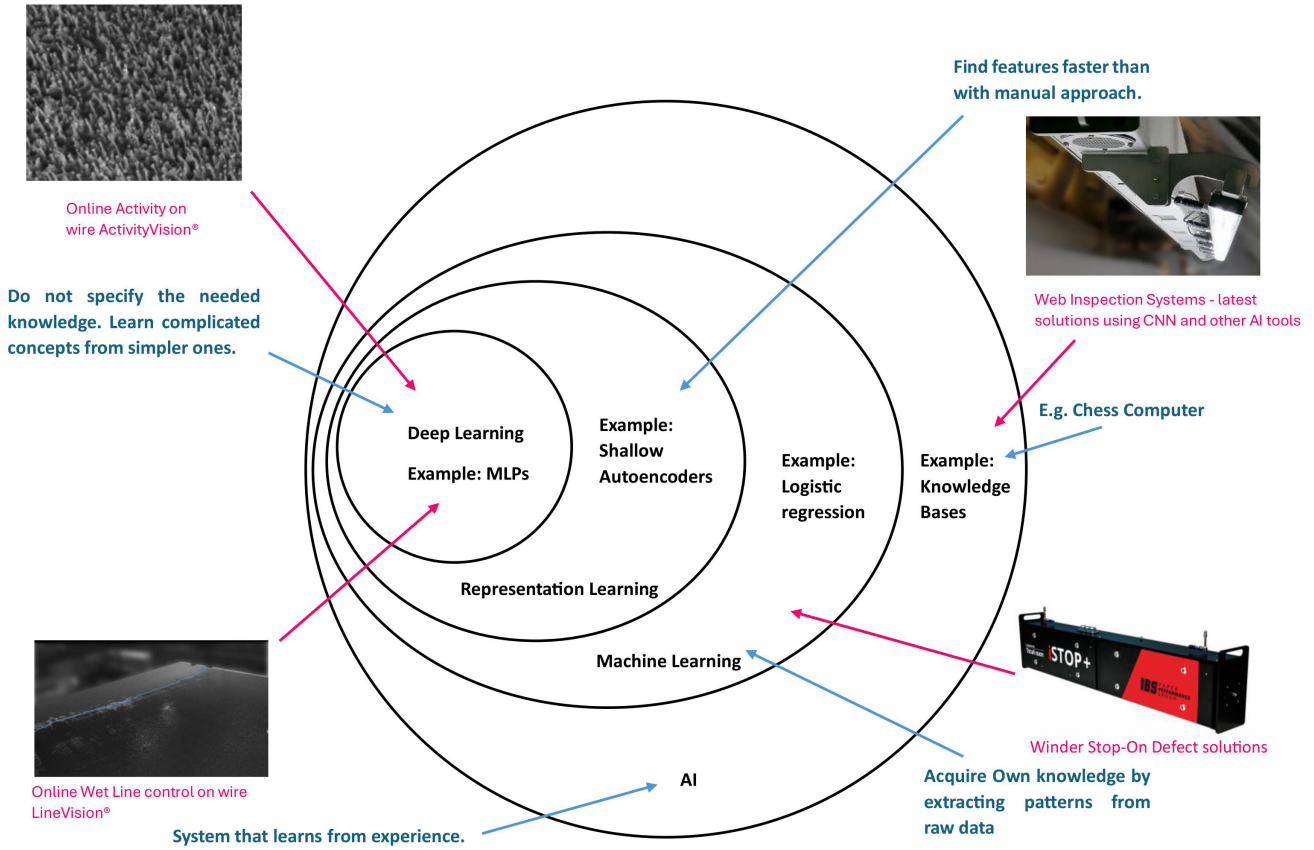*(Fig 4) Formation Monitoring*

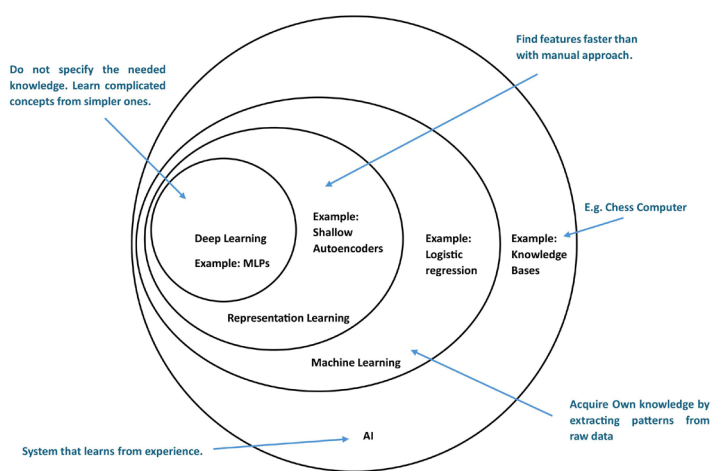*(Fig 5) Web inspection system*

(Fig 6) Web monitoring system

(Fig 7) Web monitoring system

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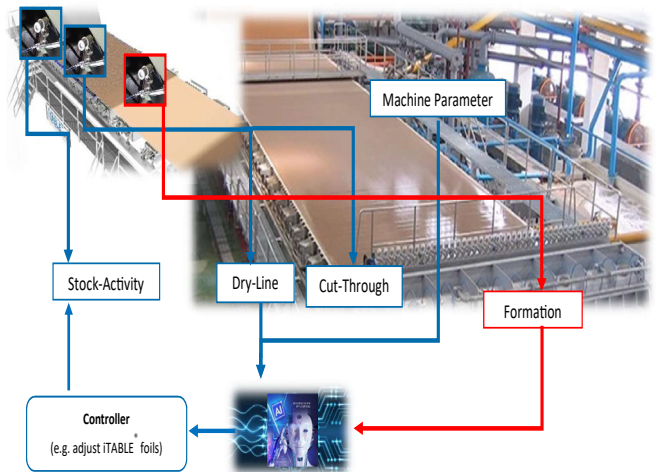## NON-MARKING WINDER AUTOMATION SOLUTION

Everything could be Artificial Intelligence

*(Fig 8)*

(Fig 9)

(Fig 10)

Decades of theory and development of many different concepts / modules / ideas, etc. Each task has a variety of possible tools for optimum performance.

For Example - „CNN "(Convolutional Neural Network) from 1943, SensorFusion, etc.

Development of Web Inspection Software based on CNN:

Total Vision is an integrated system that seamlessly merges web monitoring (fig 6) and web inspection (fig 5), creating a comprehensive event capturing solution. By empowering operators to swiftly identify breaks and defects from a single workstation, it enables efficient control over line speed and product consistency. The outcomes delivered by TotalVision (fig 10) demonstrate an impressive 80% reduction in breaks and a notable 5% enhancement in overall efficiency.
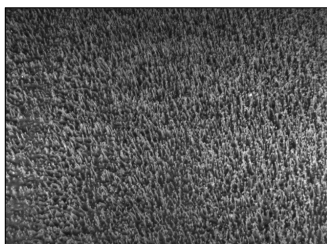
Wet Line Monitoring and Control
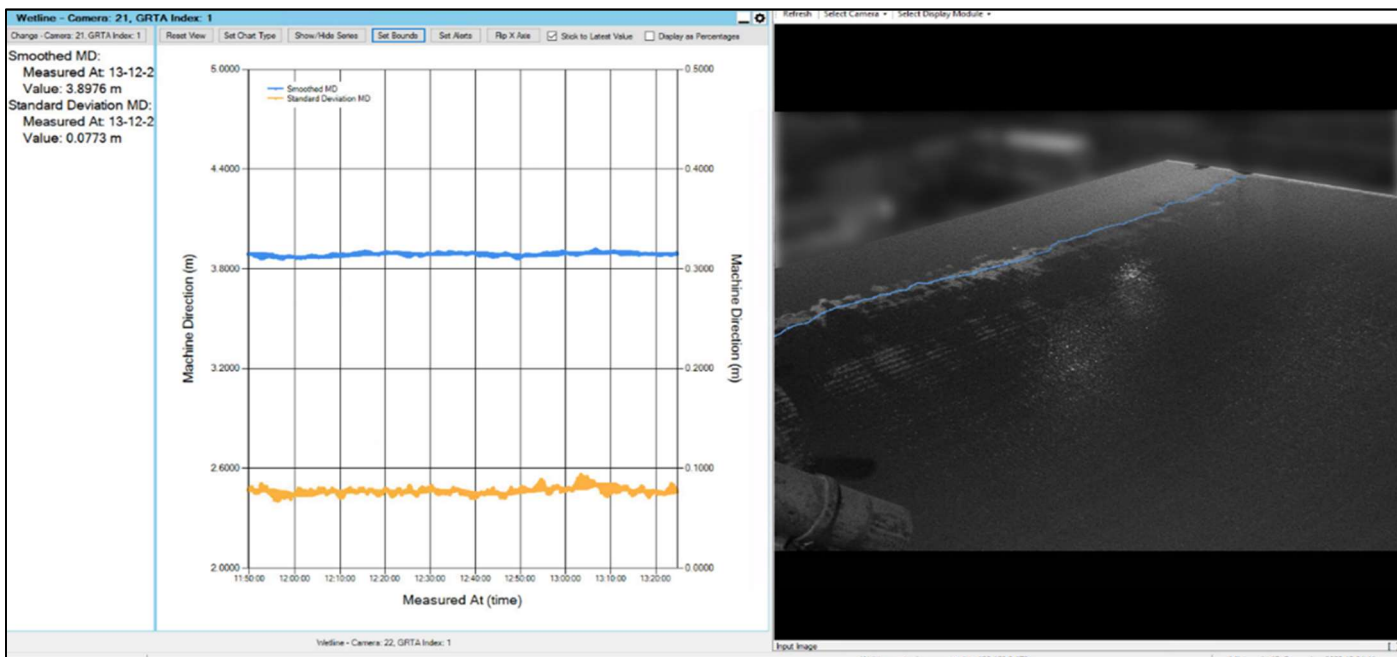
(Fig 11)

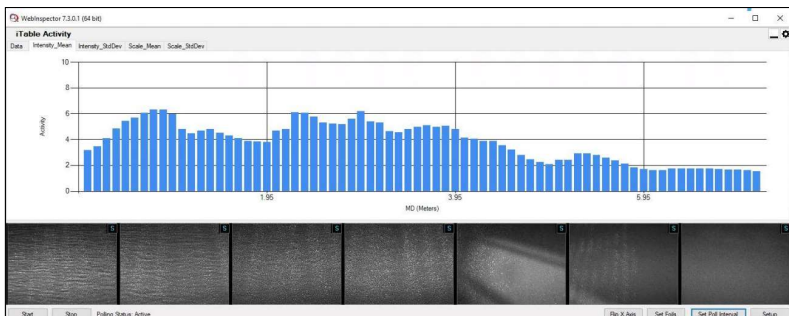**Stock Activity Measurement:**

(Fig 12)

(Fig 13)

(Fig 14)

AI to interpret the Activity Level via trained data

Stock activity measurement along the wire – potential for control loop

(Fig 15)

Web Inspector

All technologies available – Matrix and Linescan - we cover the full spectrum

Advanced 8K hardware for best resolution up and running

Artificial Intelligence based software for advanced defect segmentation and classification

AI to secure optimum Segmentation of Defects AI to organize the Classification of Defects
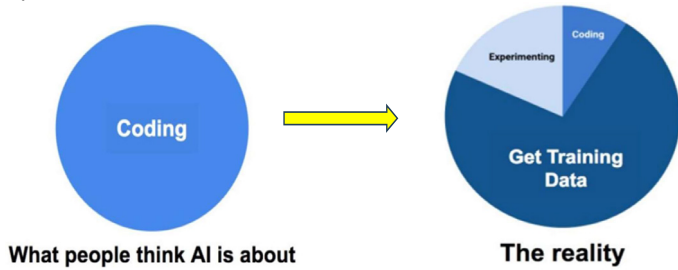

Benefits of WIS – AI

- Reliable defect segmentation based on neural networks – resistant to process variations (lighting, grade, etc.).

- Distinct classification of typical defect classes with AI model (e.g. streaks, wrinkles, shred, halos) (fig 17 & 23).

- Linescan or matrix cameras.

- Fastest start-up due to pre-trained AI model.

Training data is the key!

- Without training, the model is useless.

- Training data should contain real-world examples.

- Training labels must be created by hand (supervised learning).

How to acquire data?

- It depends on the application.

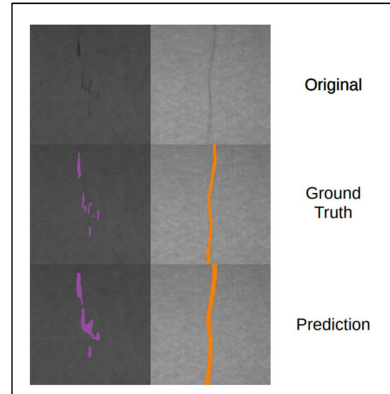- For classification, acquire object images.

Understand that training replaces programming!

WIS | Deep Learning (DL)

Input : Images / objects with samples of different classes, objects are labeled with correct class.

*Output :* Classifier who can categorize images / objects.

Features : Are selected automatically.

(Fig 16)

New Segmentation and Classification Algorithm

- Reliable defect segmentation based on neural networks – resistant to process variations (illumination, grade, etc.)

- clear recognition of typical defect classes by means of an AI model (e.g. streaks, wrinkles, holes, paper shred) (fig 17 & 23)

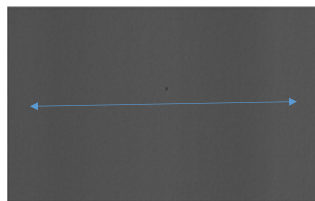- Flexible commissioning due to AI based classifier tool.
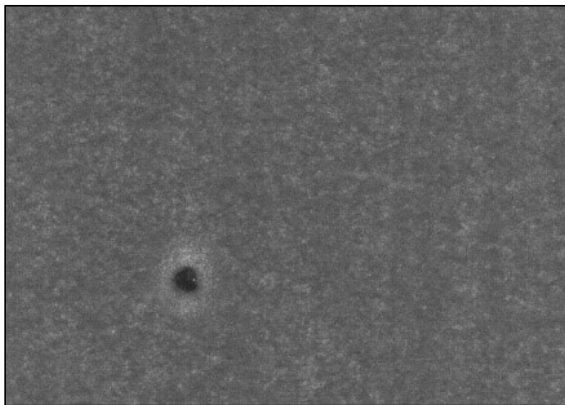
(Fig 17)
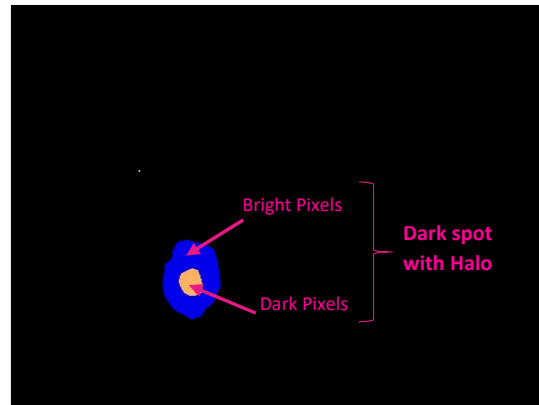
(Fig 18)

WIS – AI Classified Defects
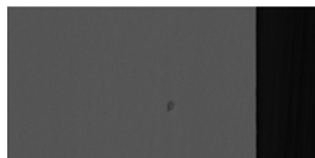
Hole

Splash

(Fig 19)

(Fig 20)

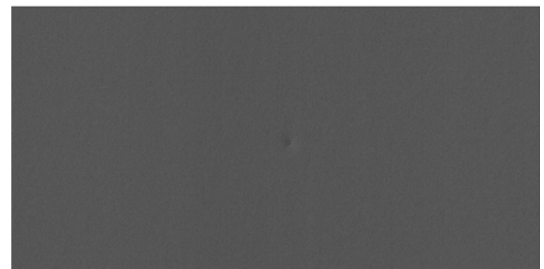1024 Pixel * 0.2mm/Pixel = 205mm

Dark Streak

Lump

(Fig 21)

(Fig 22)

Special Defect – Dent

(Fig 23)

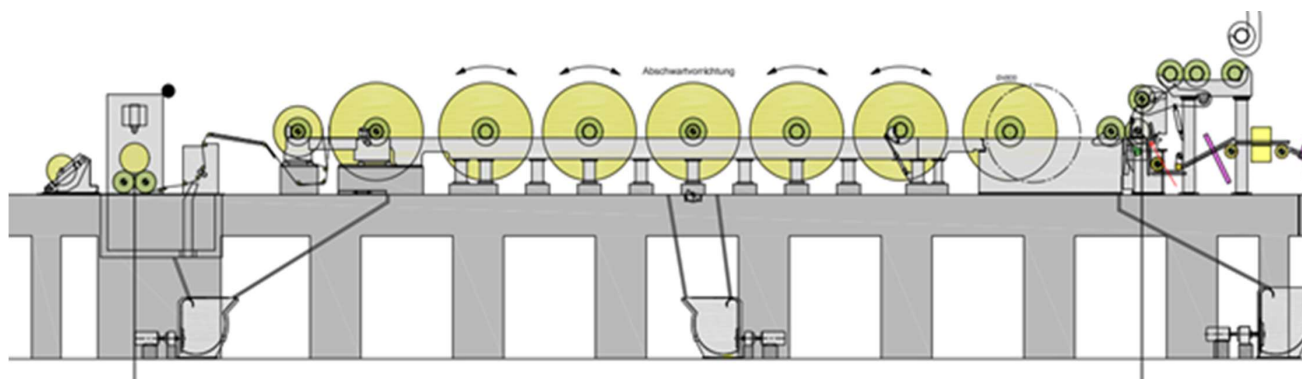AI for flexible and tailormade classification

IStop+®

Stop-on-defect on winders

Transfer defect information from Pope Reel to the Winder for further use!

Winder ⟵———————————————————— Pope Reel

How it works?

- iSTOP+TM (fig 24 & 25) camera on paper machine continuously inspects the sheet at the reel and stores unique product pattern machine direction (MD) information into the specific reel number.

- iSTOP+TM (fig 24 & 25) camera on winder continuously inspects the same sheet in the same area and finds the matching unique product pattern, or "fingerprint", resulting in the exact MD position being established.

- iSTOP+TM (fig 24 & 25) transfers continuously MD position data to winder software.

- The winder operator chooses defects to stop for, with critical ones preset for automatic stops. The winder adjusts speed or stops, optimizing its response based on the winder model and conditions. These streamlines defect during winding.
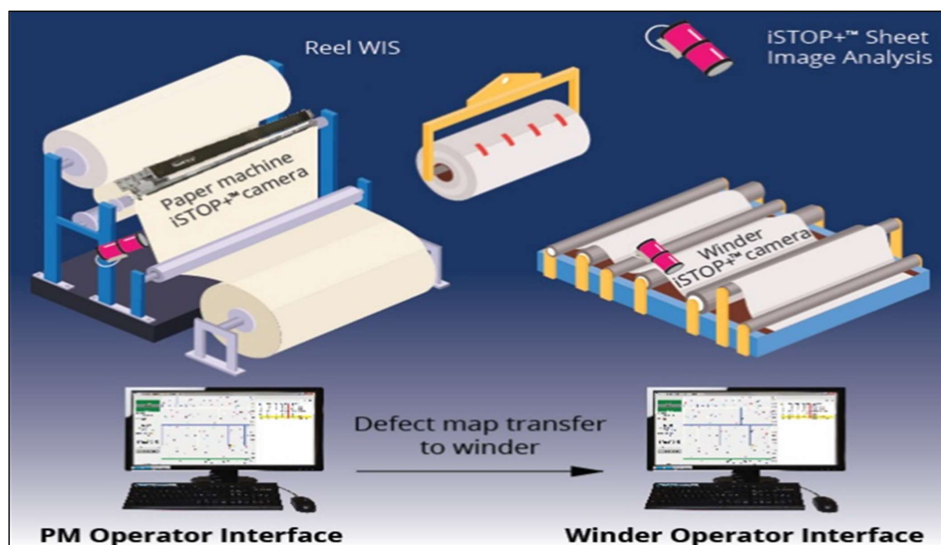
CONCLUSION:

Significantly improve defect detection and classification:

AI-powered vision systems like TotalVision (fig 10) using CNNs, identify and categorize defects (streaks, wrinkles, holes) (fig19 to 23) with high accuracy, even under varying conditions. This leads to substantial reductions in breaks and improved efficiency.

Enhance process monitoring and control:

AI analyses data from sensors like FlocVision (fig 1 and 4) and LineVision (fig 2) providing real-time insights into key parameters. This allows for dynamic optimization of the machine, especially when coupled with adjustable foils, leading to better product consistency.

Increase automation and safety:

AI-driven solutions like iSTOP+™ (fig 24 & 25) automate winder operations, improving safety by removing the need for lasers or ink in defect detection. This also streamlines the transfer of defect information from the Pope Reel, optimizing the winding process.

Essentially, AI empowers paper manufacturers to achieve higher efficiency, better product quality, improved safety, and more informed decision-making. The information suggests that AI is becoming an indispensable part of modern papermaking.