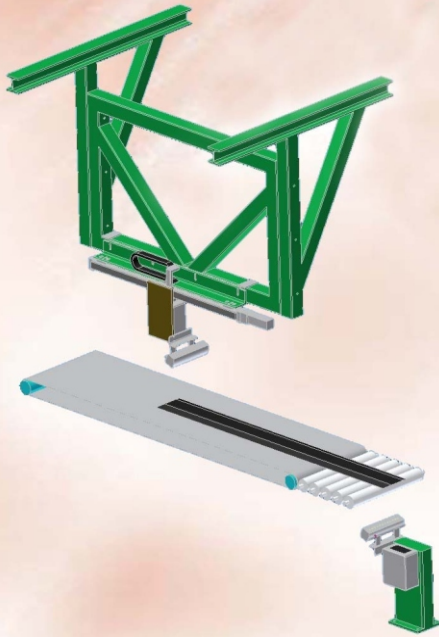


## Visual Strip Length Measurement



Rubber strips for tire production are characterized in ME-Inspection visual measurement stand for profiles and lengths. Image correlation method utilizing images of strip cut areas taken by two B&W machine-vision-graded cameras supplies offset to the nominal strip length at which cameras are positioned. Image-preprocessing involves filtering, de-convolution due to fast strip movements, and edge detection. Image processing algorithm on 512x512 pixel images with most of the processing in frequency domain is fast enough to handle top extruder performance of approx. 3 strips per second.

### Features

- geometry-independent strip cut correlation method
- two synchronized B&W cameras positioned to nominal strip lengths
- 2M pixel camera with 0.125 mm/pixel resolution
- hi-res image processing through 512x512 2D FFTs optimized for multi-core systems
- image de-blur capability for correcting conveyor speeds as large as 2 m/s
- data enhancement with image filtering and edge detection
- principal tolerance for strip yaw +/- 2°
- algorithmic tolerance for strip displacement +/- 50 mm
- strip length offset range +/- 50 mm
- repeatability of measurement +/- 0.25 mm
- indication of reliability of measurement
- repeatability of measurement +/- 0.25 mm
- running on standard 2GHz industrial PC, system performs with 3 strips per second
- modularity in software enables independent simulation and testing, fast system integration

### Description

The visual length measurement operates on rubber strip extruder plant just behind the strip cutter. Two cameras positioned at the nominal strip cut areas from top and bottom sides, synchronized by the event of strip passage in front of a photoswitch.

The similarity in cut area shapes is utilized as reference for evaluation of strip length offset; to measure it, images are de-blurred, enhanced and image cross-correlation in frequency domain is applied. To indicate invalid conditions, like deformed first and last strip in production set, measurement confidence is also evaluated.

Upper camera is mounted on servosystem axis enabling positioning in range of nominal measured strip lengths, i.e. 1500..2500mm. Cameras ALLIED VISION Marlin F201-B equipped with LINOS MeVis lenses can take 1628x1236 pixel images by 12.5 fps rate, and are capable of hardware 0..24dB gain and shutter times 20us..67s. The DC position servosystem of type BECKHOFF AX5000 comes with precision down to 0.025mm. System accounts for possible, even if minimal, skew between conveyor plane and the servosystem axis. Because of large speed of conveyor belt in 1..2 m/s range, images taken even with 1ms shutter times are blurred, which could reduce the final measurement precision several times. With implemented image de-convolution, the effective image structure edges are kept within 2-pixel range, and the final repeatability/precision of length measurement is +/- 0.25mm. Modular system architecture with independent image acquisition and evaluation interconnected by decentralized data payload buffering subsystem regularly enables early off-production system simulation and tests, which is then experienced in fast system integration on the plant site with minimum subsequent modification and tuning.