



MECHANICAL AND AUTOMATIVE ENGINEERING

L100 X-RAY LINE DETECTOR FOR FAST IN-LINE APPLICATIONS

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In the context of a strategic alliance with Fraunhofer IPMS and Fraunhofer FEP, a novel X-ray line detector was developed. X-ray detectors are gradually replacing the X-ray films still common in radiography today and are essential for X-ray computed tomography. In conventional indirectly converting detectors, the incoming X-ray photons are converted into visible light, which is then converted into electrical signals by photodiodes for subsequent processing. The intermediate step of converting the X-ray photons into light photons has potentially negative effects on the detector's resolution and linearity. To overcome this difficulty, the L100 X-ray line detector presented here works as a directly converting detector, which means that the X-ray photons are directly converted into electrical signals in a kind of a photodiode.

The advantages of this concept are a significant improvement in resolution and linearity as well as the possibility of estimating the energy of each photon presented by the single-photon sensitivity, which in turn can be efficiently used for dual-energy applications, such as material sorting.

Line detectors are used when moving objects need to be analyzed or if the size of the test specimen only permits the use of a well-collimated illuminating beam for elimination of undesirable scattered radiation. The line detector developed in the present work is assembled using application-specific integrated circuits (ASICs) to enable low-cost manufacturing and high configuration flexibility.

The prototypes currently under test have a line length of 102.4 mm and achieve a resolution of 100 μm in test conditions.

They can be constructed with two different kinds of absorber materials, enabling detection of X-ray photons in energy ranges of 30–200 keV and 2–40 keV. Thus, the X-ray line detector can be used for both imaging and diffraction applications. The minimum counting time of the detector is 20 μs , which makes it possible to examine the test objects at a speed of around 50 m/s (dependent on the test design).

Combined with the XVision X-ray computed tomography control and analysis software, customized X-ray microtomography systems with intuitive user interfaces can be constructed.

- 1 L100 X-ray line detector, complete system.
- 2 Close-up of the active area of the L100: absorber (upper left) wire-bonded to the readout electronics (lower right).