

# Measurement of Security Features on Banknotes



## Field of Application

- VIB: Vibration Measurement by Laser-Doppler Vibrometry
- LSV: Speed and Length Measurement by Laser Surface Velocimetry
- TOP: Surface Topography Measurements by White-Light Interferometry
- ST: Measurement of Spectral Properties by Spectrometers

Various security features on banknotes are intended to protect against counterfeiting and to help in recognizing counterfeit notes. A common characteristic is raised print – the result of a special printing process. This is what typically gives banknotes their unique feel, whereas the printing height of counterfeit notes is often quite flat and difficult to sense. The inspection of print height can be done quickly and easily with White-Light Interferometry.

## Security Features on Banknotes

On a Euro banknote, for example, the value numerals and the displayed architectural themes (windows and gateways) will feel rough to the touch. In particular, a distinctive tactile profile is applied at the abbreviations of the European Central Bank in the various national languages (BCE, ECB, EZB, EKT, EKP; see Fig. 1) and the vertical striping.

## Inspection with White-Light Interferometry

After printing, banknotes should be inspected with respect to the correct printing height to make sure that the required minimum height is achieved. Polytec's TMS-300 TopMap In.Line Interferometer with a field-of-view of about 20 x 20 mm<sup>2</sup> was used for the measurements. This method allows for the determination of a complete 3-D profile of a macroscopic area in just a few seconds.



Fig. 1: Security feature in the region of the bank identifiers

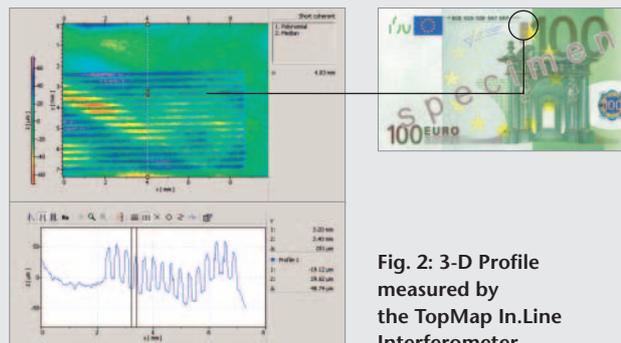


Fig. 2: 3-D Profile measured by the TopMap In.Line Interferometer

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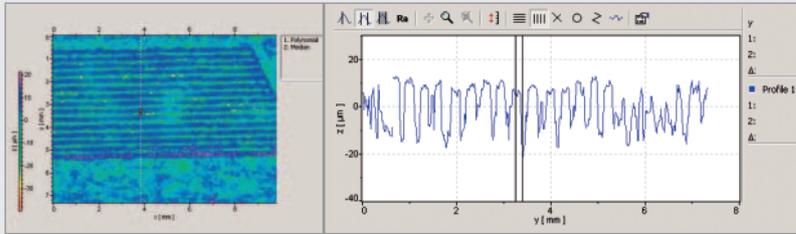


Fig. 3: 3-D Profile of a counterfeit banknote



The TopMap In.Line  
White-Light Interferometer

The result is shown in Fig. 2. As it can be seen, a simple line profile is not sufficient for reproducible measurements, because not only the paper width, but also the printing height, vary within the inspected area. Thus the results would depend strongly on the location of that profile line. Polytec has developed a special procedure wherein the edge of the structure to be measured is recognized by the software and several line profiles are set always at the same distance from the edge. In this way the subjective setting of the profile lines by a person is eliminated.

This procedure has been developed in cooperation with banknote printing companies and approved for inspection and quality control. Counterfeit banknotes (Fig. 3) can be easily detected using White-Light Interferometers.

#### Inspection of the Printing Plate

In addition, the system can also be used to inspect printing plates for flatness and for proper contours of the recesses. The macroscopic field-of-view makes measurement faster and more reliable.

#### The TopMap In.Line White-Light Interferometer

The TopMap In.Line is the ideal system for precisely measuring preset surface specifications (flatness, topography) while maintaining high product throughput, such as in production control. The measurement itself is very fast and can be completely automated. The vertical resolution is a few nanometers and, depending on the task, different fields-of-view are available (from 4.2 mm x 5.5 mm up to 19 mm diameter). The TopMap's open software architecture allows routine tasks or customized user interfaces to be easily programmed.

#### White-Light Interferometry

White-Light has the distinctive feature, in contrast to coherent laser light, that interference occurs only within a small "coherence length". In a typical White-Light Interferometer the light emitted by an LED is split into two beams. One beam is directed onto a reference surface and the other onto the surface of the workpiece. The reflections from the reference surface and from the test surface are then superimposed. If the distance to the two surfaces is exactly the same, maximum constructive interference can be seen as an increase in intensity. Otherwise, destructive interference occurs and the intensity is decreased. It is the calculation of maxima and minima of interference that allows for the precise determination of distance. If the reference mirror is

then moved, then for every point on the surface you will get an intensity correlogram. At the maximum of the envelope of this correlogram, the distances to the reference surface and the test surface are exactly the same. In this way the workpiece is scanned in a vertical direction and the topography of the complete surface area is determined using a camera.

#### Short Outline of Intaglio/Gravure Printmaking Techniques

- Recesses are engraved into the printing plate.
- Recesses are filled with ink.
- Paper is placed on top of the printing plate.
- The press roller forces paper down into the recesses of the printing plate so that the paper comes into contact with the ink.
- Plates are usually made from copper or zinc.
- Formerly used extensively for high-quality magazines, fabrics and wall papers.
- Common uses still include some postage stamps and U.S. paper currency – at one time used for all mass-printed materials including banknotes, stock certificates, etc.

Intaglio printing: The paper rests on top, to which a slightly raised layer of ink adheres; the printing plate is beneath (image: Wikipedia).



For more information about surface metrology by Polytec please contact your local Polytec sales/application engineer or visit our web page [www.topmap.info](http://www.topmap.info)

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