



Image Processing | Optics / Lasers | Technology Offer

Optimized filters for image feature recognition, e.g. for surface inspection

Field of application

The recognition and extraction of image features, i.e. their general classification, plays a major role in digital image processing. For example, for surface inspection, images are taken of surfaces in order to identify different classes of surface defects. However, objects of the same class may occur in various sizes, which poses a challenge to the conventional image processing methods available. Solutions that are actually adapted to the respective image feature would considerably improve the reliability and stability of these analysis methods.

State of the art

The dyadic and M-channel wavelet filter banks that have been widely used cannot be optimally matched to the different sizes of the image features due to their integer scaling. That means their use is far from satisfactory for all kinds of applications.

Innovation

The filter process according to the invention was developed within the framework of a research project carried out by the University of Applied Sciences Pforzheim in cooperation with the Fraunhofer Institute IOSB and the Karlsruhe Institute of Technology KIT. It uses tailored "rational biorthogonal wavelet filter banks". The design is carried out in two steps: first the most suitable rational scaling factor is determined and then the filter coefficients are matched to the image characteristics. Biorthogonal filters are used to create higher degrees of freedom.

The new analysis method was tested in a series using deflectometry for the detection of defects on specular surfaces. The method achieved a much higher degree of selectivity in defect classification than conventional methods. The corresponding detection rates are also superior to those of known methods. This is illustrated by the figure showing exemplary test results. The invention concerns this method of analysis as well as its implementation into existing systems. The customized filter banks can be integrated into existing systems to optimize feature recognition.

Patent portfolio

EP granted (EP 2977933 B1), validated in DE, FR & GB.

Your benefits at a glance

- ✓ Significantly higher detection rates and selectivity in the classification of image features
- ✓ Filter banks and their components are specifically adapted to characteristic features
- ✓ New software can be easily integrated into existing systems and processes

Standard method	Accuracy		
	C_d	C_p	
Correlation filters	60%	66%	
Biorthogonal spline wavelet 3.5	88%	35%	
Method	Matched	C_d	C_p
MCFB	C_d	90%	73%
MCFB	C_p	67%	78%
RWFB	$C_p, t=1$	75%	70%
RWFB	$C_p, t=2$	84%	84%
RWFB	$C_p, t=3$	95%	89%

Method	Accuracy	
Thresholding	70%	
Biorthogonal spline wavelet 3.5	68%	
Method	Matched	Accuracy
RWFB	$C_s, t=1$	94%
RWFB	$C_s, t=2$	95%
RWFB	$C_s, t=3$	96%

Figure: The left table shows an increase of classification results due to the increased number of attributes (t) considered for an object and illustrates the advantage of rational biorthogonal filter banks (RWFB) over M-channel filter banks (MCFB). The table on the right illustrates the advantage of differently structured RWFBs (below) over the use of "thresholding" or standard wavelets (above). The accuracy of the classifications for the feature classes C_d (dent), C_p (pimple) as well as C_s (stain) is shown, taking into account different resolution levels t.

Technology transfer

TLB GmbH manages inventions until they are marketable and offers companies opportunities for license and collaboration agreements.

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