研究速報

A Miniaturization of an Optical Matched Filter

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It is reported that a miniaturization of an one-lens matched spatial filtering system with reflection type volume hologram is successfully achieved using a small lens of 3.3 mm diameter and 3.65 mm focal length. These experimental results show that the integration of matched filters with a density of 9 filters/cm^2 is possible to make a parallel-processing pattern recognition system

1. Introduction

An optitcal/digital pattern recognition system composed of integrated matched spatial filters with a microlens array and digital computer has been proposed as a model of biological visual perception.[1] In this system, the features of the image of an input object are extracted in parallel by comparison with the standard patterns recorded in a "microhologram" made by planer microlens array.[2] The extracted information is then processed by microcomputer to be synthesized as an image corresponding to an input object, which is finally recognized in comparison with memorized standard patterns.

In order to realize the feature extraction part of this proposed system, shown in **Fig. 1**, integrated matched filters must be developed using a microlens array.

In this letter it is shown that matched filtering with a small lens of 3.3 mm diameter is possible.

2. Experiments and Results

Some techniques to achieve an integrated matched filter system have been developed,[3] but these systems do not have a degree of integration sufficient to make our proposed system. As a first step toward achievement of a much more integrated matched spatial filter, a reflection type with a small lens with the diameter of 3.3 mm and focal length of 3.65 mm was constructed. The reflection type matched filter was chosen because of its high diffraction efficiency.[4]

The exposure setup is illustrated in **Fig. 2**. Since the numerical aperture of the microlens was very small, we had to set a small diffraction angle of 5 degrees. An alphabet letter "A" 2.0 mm in height was used as the reference object. The reflection type matched filter was exposed on Agfa 8E75HD photographic plate and the exposed photographic plate was processed in GP 62 developer and GP 432 bleacher to obtain a phase grating filter.[5]

A matched filtering setup is shown in **Fig. 3**. To construct the one lens matched filtering system, a reflected correlation signal beam was led into the same lens as that used for Fourier transform when recording. In this setup, the double diffraction system was used to image the object pattern on the input plane. The beam of the correlated

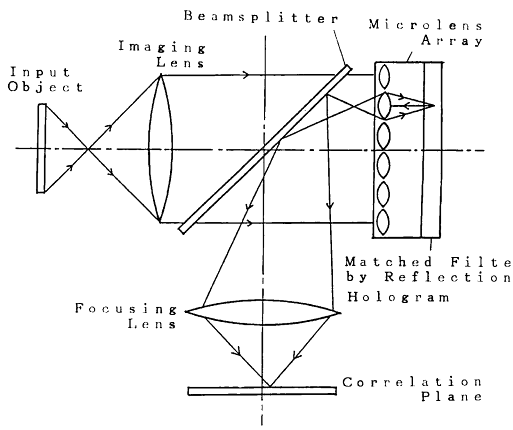

Fig. 1 A proposed system for an optical pattern recognition with planer microlens array and reflection type matched filters.

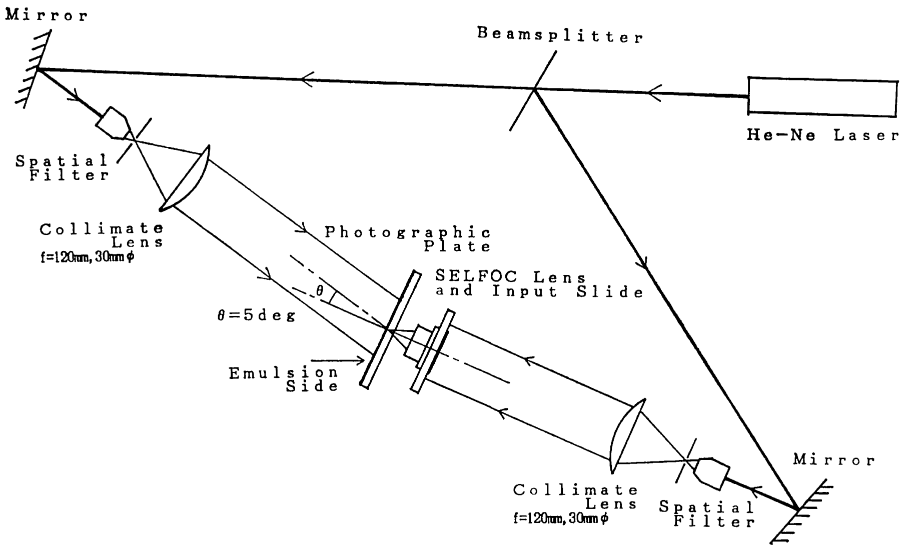

Fig. 2 The setup for synthesizing a matched filter with a small lens and small angle of reference beam. The diameter of the selfoc lens was 3.3 mm, the incident angle of reference beam was chosen as 5 degrees. The image of the letter "A" with a height of 2.0 mm was used as input object.

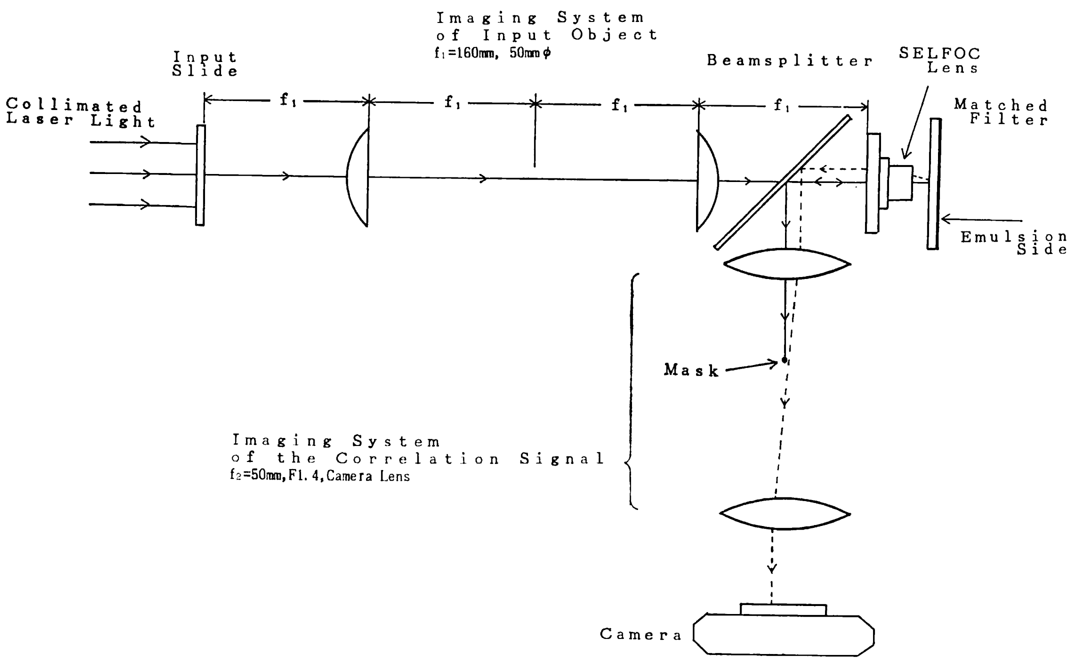

Fig. 3 The matched filtering setup. A double diffraction system was used for imaging the input object pattern on the input plane. A beam splitter picked up the correlation beam and the peak image was recorded on a photographic film in a camera.

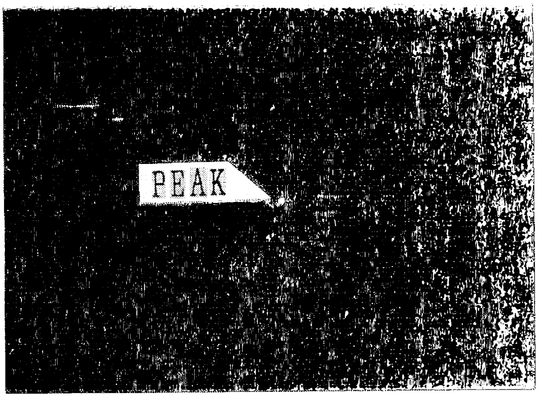

Fig. 4 The observed correlation peak.

signal was also focused by the Fourier transform lens and picked up by a beam splitter. Then the correlation spot was recorded on a photographic film in the camera using the imaging optical system as shown in **Fig. 3**. The mask shown in the figure was used to reject reflection noise from the glass surface of the photographic plate. The observed correlation peak is shown in **Fig. 4**.

3. Conclusion

Experimental results show that one element of the proposed pattern recognition system in **Fig. 1** can be constructed with a small 3.3 mm diameter lens. If a lens array is made using a lens of this size, an integrated matched filter with a density of 3×3 filters/cm^2 can be achieved.

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