August 1973 B73-10242

NASA TECH BRIEF

Langley Research Center

Improved Photographic Prints With a Linear Radial Transmission Filter

The problem:

Photographic negatives often contain much subtle detail and fine structure which print poorly or not at all by conventional means. This is due to the small dynamic range of print paper. In addition, film graininess can be objectionable when sufficiently enlarged. Presently used printing methods are limited by cost and complexity or lack professional efficiency and quality.

The solution:

In order to reduce or eliminate these problems, a set of techniques was developed, each using a Linear Radial Transmission Filter (LRTF), to achieve improved prints. The LRTF is easy to use and yet results in prints which depict more of the information contained in the negative than can be shown by direct printing.

How it's done:

The LRTF is an optical-quality filter which has maximum transmission in the center and a linear drop in transmission radially out from the center.

When a LRTF is placed at the stop (location of the lens iris) of an enlarger lens, the focused image is not affected except for a drop in brightness, but an out-of-focus image will change considerably. The reason for this is shown in the ray-tracing illustration (Figure 1).

The light from each point on the negative uniformly fills the enlarger lens, which is stopped to the LRTF diameter, and is focused to the image point. Examination of the central (1) and edge (2) light rays reveals that, if the light is examined ahead of or behind the focused image point, the out-of-focus area will have a bright center and a dim edge; in fact, it will be a small image of the LRTF. The intensity distribution over the unsharp image of each point of the negative will be similar, with a constant size at a given unsharp focus plane. The unsharp image will be larger closer to the lens and is called the unsharp smear. The intensity distribution across the unsharp smear is triangular (Figure 1). This is the reason for the high efficiency of the LRTF method.

The unsharp smear of fine structure in photographs by the LRTF is highly efficient in blending these together. The smearing can be used directly to remove image graininess at a minimum loss of image sharpness. It also can be used to make an unsharp mask, which allows selective small-detail enhancement.

The unsharp mask, which is a positive transparency, is either placed directly on the print paper or stacked with the negative. A sharp image from the negative is then printed. The amount of defocusing used to make the mask determines the scale of features that are enhanced. The contrast of the mask determines the degree of flattening of large-scale contrast in relation to small-scale contrast.

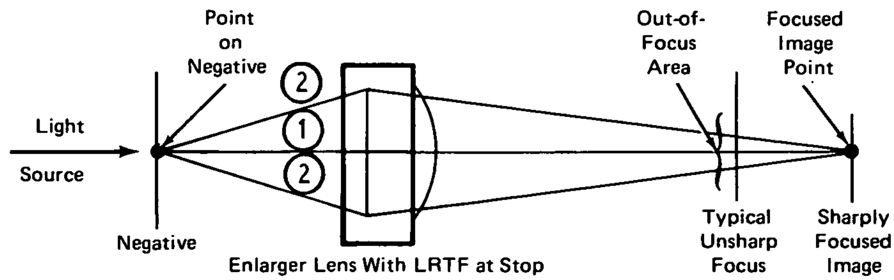

Figure 1. Geometric Optics Ray Tracing Through Lens With LRTF.

(continued overleaf)

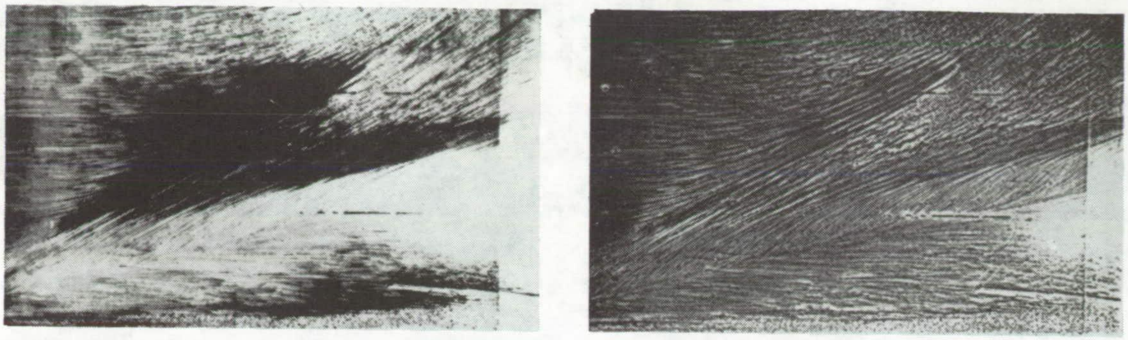

Figure 2. Oil-Flow Photographs.

An example (Figure 2) is an oil-flow photograph from a wind-tunnel study. The original photo on the left had regions of heavy oil accumulation, which shows up darkly and also has glare. It was desired to show only the oil-flow pattern, with little or no large-scale contrast. To do this, the unsharp mask was made with a contrast index of close to one, and the mask negative stack was printed on fairly high contrast paper. The improved result shown on the right is close to what was desired, with a small glare spot remaining.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
Langley Research Center
Mail Stop 139-A
Hampton, Virginia 23665
Reference: B73-10242

Patent status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:

Patent Counsel
Langley Research Center
Code 456
Hampton, Virginia 23665

Source: Leonard M. Weinstein
Langley Research Center
(LAR-11221)