OPTI-502 **Optical Design and Instrumentation I** John E. Greivenkamp

Practice Project 4

Flash!! In response to the unbelievable success of the Dis-Advantix camera, Kodak introduced its own single-use APS camera. (It's called the Advantix Access.) Your company decides to fight back with an autofocus APS camera in order to compete in the higher-end portion of the market. Your task is to design the autofocus system for this APS camera.

To refresh your memory, the APS film format is
16.7 mm x 30.2 mm The film is 24 mm wide.

The print format for which the image blur requirement is defined is the "Classic" format; the print will have a 2:3 height to width ratio, and an example print size is 4 x 6 inches. The entire active area of the APS negative is not used or exposed in this format.

Camera Specifications:

Objective focal length: 26.0 mm
Objective f/#: f/2.8
Acceptable blur due to defocus: equivalent to a 0.004 inch blur on a 4 x 6 inch print.
Uses an area on the film of 16.7 mm x 25.0 mm.
Object focus range: 4 feet to infinity.

<u>Part I:</u>

To focus the camera, the objective lens is moved to one of N discrete longitudinal positions. Each lens position covers some segment of object space.

Determine the number of lens positions that is required to meet the total focus range of the camera. This is called the number of focus zones. Provide a list giving the nominal object position for each zone.

<u>Part II:</u>

Design an active triangulation autofocus sensor for this camera. It will use a single LED and a linear detector array. Two identical lenses are used.

LED size:	50 µm x 50 µm (square)
Sending and receiving lenses:	f = 20 mm
	Size: 8 mm x 8 mm (square)

The light from the LED is "collimated" by placing it at the front focal point of the sending lens. Assume that the object is large, flat and diffusely reflecting.

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There is one detector element for each focus zone. The returned spot of light for each nominal object position must be in focus on the array, and the spots corresponding to any adjacent nominal focus positions are non-overlapping. Object locations between the nominal positions will produce a spot that falls on two detector elements.

Determine the linear detector array geometry (including the pixel sizes and its position relative to the receiving lens) and the minimum lateral separation L of the sending and receiving lenses on the front of the camera.

Reasonable approximations can be made for this design. Be sure to note and justify assumptions you make.

Hints:

- To determine the autofocus zones, start at infinity and work in to 4 feet. Determine the nominal object position for each focus zone.
- To begin the design of the autofocus system, first determine the size of the projected spot from the LED at each nominal object position.
- Re-image these projected spots through the receiving lens, noting the size of the imaged spot and its location (both lateral and longitudinal). Some of these results will be in terms of the lens separation L.

Note:

While the problem as stated is pretty well constrained, there are many interesting trade offs in the design of an autofocus sensor. For example, no radiometric or signal processing considerations are included. You may want to think about what changes could be made to this design in order to reduce the lens separation or to reduce the focal lengths of the sending and receiving lenses. In practice, you would probably not require non-overlapping spots.