

ANALYSIS OF IMAGE FORMING SYSTEMS

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In recent years, electro optical image intensifier devices have been extensively developed for use in military activities requiring visual surveillance under extremely limited visibility conditions. In principle, these sensitive light pickup elements allow a considerable increase in visual target acquisition and image display capability. Low level images may be intensified enormously by electronic amplification. Quantum limited signals may be integrated for long time periods and readout by continuous non-destructive readout techniques. Active light pulse storage systems may be used for the storage and continuous display of transiently illuminated scenes. Active infrared intensifier systems are feasible which combine a high degree of performance with a relatively high level of visual security for the user.

The variety and complexity of intensifier devices which are possible and the development cost associated with each indicate the need for realistic system selection and performance evaluation techniques. This paper presents a brief survey of the methods and procedures which may be utilized for the solution of problems involving military visual surveillance thru image intensifier devices under low light level conditions.

B. GENERAL SYSTEM CONSIDERATION

The image intensifier may be considered as in the nature of a black box with input and output terminals coupling a target message located in object space to the visual communication channel of the human network with interpretive and decision making capabilities. In battlefield surveillance radiation patterns modulated by ground objects travel through long air paths into the input terminals of the intensifier, the objective lens. After undergoing suitable modification and alternation by electronic processes, an output visible image is presented to the human observer for interpretation and decision making. The complete system is shown in Figure 1.

We may consider that the interpretation process does not contain a continuum of values but is restricted or quantized into five distinct levels of activity:

1. No detection
2. Detection
3. Shape orientation
4. Shape recognition
5. Detail recognition

In other words these are the five distinct degrees of freedom or states of image intensifier system. Obviously these decision states depend on the characteristics of the optical message, the properties of the intensifier device and the psychological responses of the human readout processes. What is required for evaluation purposes is a transformation arithmetic which allows determination of the most probable value of the decision state of the complete system as a function of the various component variables.

THE IMAGE INTENSIFIER SYSTEM

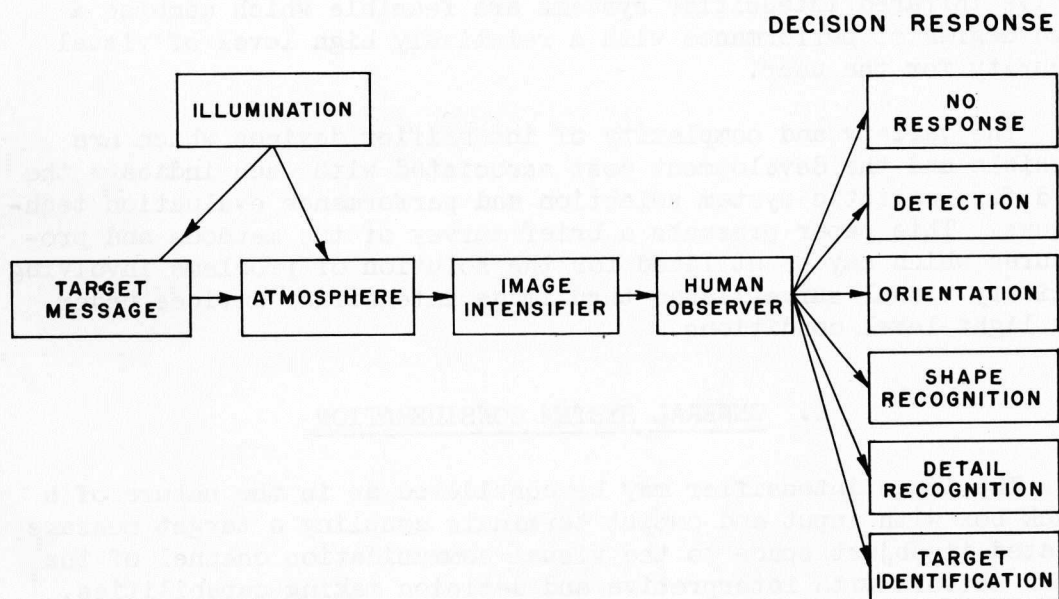


Figure 1

C. DEFINITIONS OF INFORMATION FLOW

The choice of a fundamental quantity to act as an information carrier in an image forming system corresponds to the selection of a suitable coordinate system in which to cast and examine a physical problem. While many coordinate systems are possible there are a preferred few in which the problem may be solved in as simple a