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On the Invention of Modulation Transfer Function

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Abstract

This article explains and discusses the details of how modulation transfer function is invented. This particular function is practical in image engineering in information technology. And its invention entails basic knowledge of trigonometry, Dirac delta function, and Fourier analysis. Moreover, it is invented using familiarity with the point spread function and the line spread function created in physical optics. This function is an integral representing the Fourier transform of the line spread function. The invention is achieved through rigid experience in synthesizing diverse knowledge for producing a meaningful formula.

Key words: Information technology, Image contrast, Modulation transfer function

調制傳遞函數的發明過程

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摘要

本篇論文詳細解釋調制傳遞函數的發明過程。調制傳遞函數在資訊技術中的影像工程內具有實用的價值。發明此函數需要有扎實的工程數學知識，尤其是三角函數，Dirac delta function，以及傅立葉分析法。除此之外，發明此函數之前也須要對物理光學中的點擴散函數和線擴散函數有深入的瞭解。此函數最後的型式是線擴散函數的傅立葉積分轉換方程式。此方程式的發明過程來自於紮實的工程模式分析法的經驗與技巧，將不同的知識合成起來，並且運用數學推導出有意義的公式。

關鍵詞：資訊科技，影像對比，調制傳遞函數

1. Introduction

Evidently, modern engineering analysis will focus attention on nanotechnology, biotechnology, energy, and information technology (IT). Where IT is concerned, image quality of information transferring, regardless in digital or analog, will always be central in producing satisfactory engineered pictures. Generally, there are five parameters in image quality analysis: depth of field, distortion, perspective, resolution, and contrast.[1] But in this paper, only one parameter is discussed: the contrast.

Three definitions of contrast have been used in image analysis: simple contrast, Weber contrast, and Michelson contrast. Among them, Michelson contrast is the most common one.[2] Michelson (Nobel laureate in physics, 1907) adopts luminance (L) which is the reflected light flux or light intensity for constructing his definition:

$$\text{Michelson contrast} \equiv \frac{L_{\max} - L_{\min}}{L_{max} + L_{\min}} \qquad (1)$$

In Eq. 1, the difference in the numerator and the sum in the denominator can be understood from Figure 1 in which sinusoidal graph is used for representing the black-and-white contrast.