# Discrete representation and morphology

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**Abstract**

In discrete signal acquisition, the achieved 'resolution' depends on the limitation and properties of the whole measuring system: detector, amount of the discriminable points, sensitivity, dynamic range, sampling, quantization, signal to noise ratio, gain, transient response function in spatial or frequency domain. The basic attributes of the measurements are a) responsivity: a conversion qualification of the measurement device, which is given as the functional dependence between the input and output quantities. b) discriminability: the quality to discern and perceive of differences between two similar object. c) distinguishability: two distinguished values have to share the same neighborhood values, a set of non-empty values is required to distinguish between the values.

It is inherent to continue with the terms from mathematical topology and morphology, which were developed as the unified branch in mathematics, originated from the geometry. Thus, it is able to generalize basic terms via abstraction of shape, and therefore it offers formal definitions for structural characteristic as well.

**Responsivity**

Responsivity is a conversion qualification of the measurement device given by functional dependence (transfer function) between input and output quantities (variables). It is a ratio between output signal y and measured property x. Ideal dependence is given by linear function y = K*x. where K is the responsivity and it is also a parameter (constant variable) of a transfer function [1]. It is constant only in linear case. Therefore, for multi-range sensors it is necessary not to set only the proper range for expected values but also to measure at the upper third part of the range to obtain the best precision of the output [2]. The responsivity is almost constant in upper third part of the range, incase of logarithmic transfer function. The responsivity may vary rapidly in the lower part of the range while only small change of input value is measured.

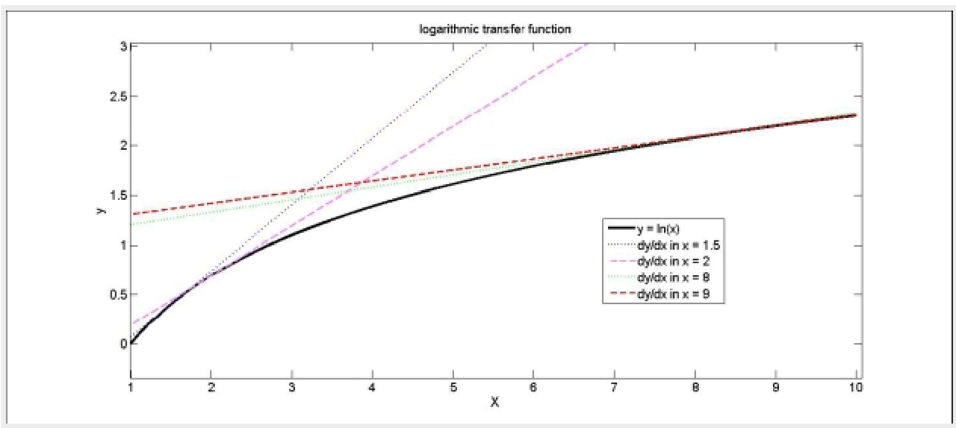


**Figure 1**: Illustration of logarithmic transfer function and differences ofresponsivity in lower and upper third part of the function.

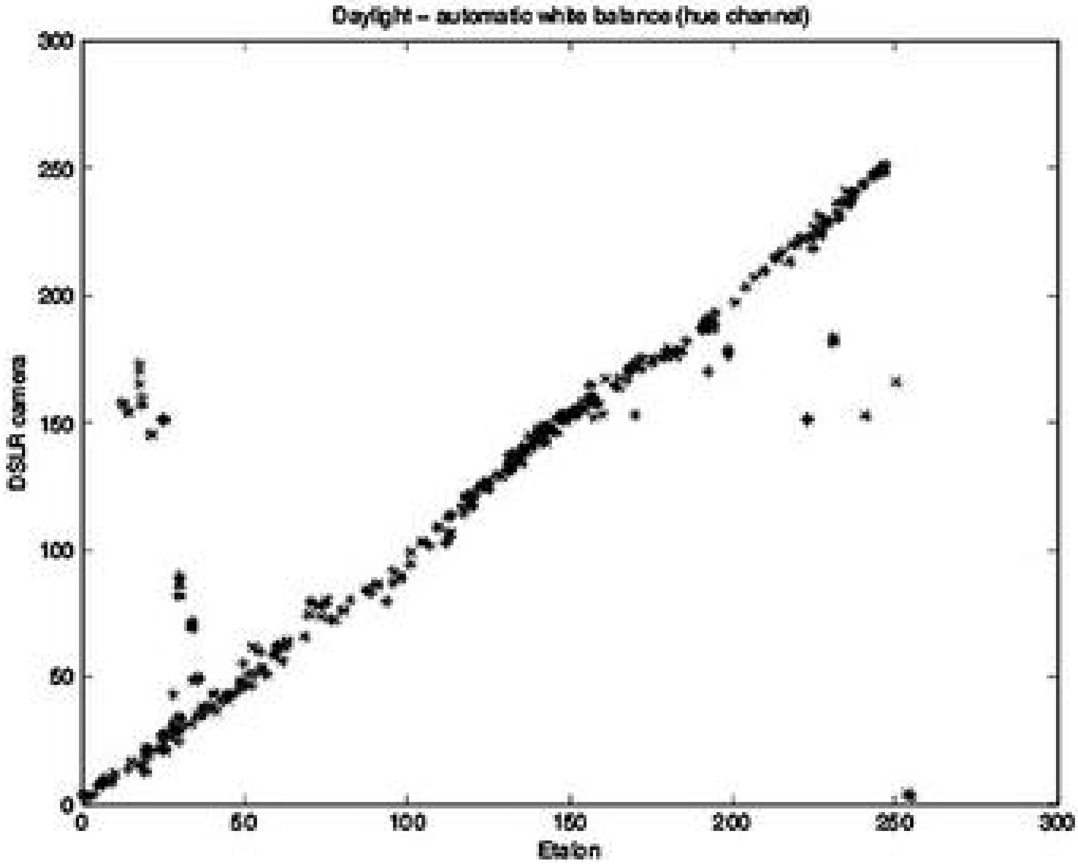


**Figure 2**: Example of DSLR digital camera responsivity function for the hue colour channel using white balance settings under daylight condition.

### Discriminability and distinguishability

In order to investigate the terms of discriminability and distinguishability it is natural to include terms from the field of topology [3]. Topology is one of the unified branches of mathematics, and it is the study of qualitative characteristics of spaces. While topology generalizes shapes via abstraction, it also offers more formal definitions to describe some structural characteristics. The concepts of discriminability and distinguishability create differences between mass values of the same peak and mass values of the other mass peaks.

**Distinguishability**

Distinguishability is usually considered as the same conception asthe resolution, however distinguishability is mathematically differentterm. To distinguish two values is required an nonempty set of values which can be used to distinguish between the two values. Therefore, minimal distinguishability is given by the resolution. Two distinguish values have to share the same neighborhood values. While distinguishability can be achieved in practice, the resolution is a theoretical potency estimated via calibrations. The practical impact is immediate. The theoretical resolution equals the distinguishability only in the ideal case.. The distinguishability for real measurements is usually worse than the theoretical resolution.

**Discriminability**

Discriminability is the quality to perceive the differences from anotherlike object. Discriminability could be less then the resolution. It is the ability to recognize observation of two values, but not to distinguish them to each other. Additionally, topological discriminability is the quality to perceive or discern differences between two similar objects. Therefore, discriminability quantifies not only the position, but also the distance. The formal definition of discriminability is as follows: "*Two objects are discriminable if there is an open sentence that is satisfied by one of the objects and not the other. If all the objects of domain are discriminable, then each of them uniquely satisfies infinite conjunction. Each real number is uniquely determined by the set of all the sentences that it satisfies. Ordinal numbers are only moderately discriminable, since any two of them satisfy the open sentence in one order an not the other*" [4].

Distinquishability is quantitative property and discriminability is qualitative property. However, discriminabilaty should be computed, but the result is not precise. In other words, two discriminable values are two close values which differ. Two distinguishable values are two values far from each other at least by the resolution and there is at least one different value between them.

So-called resolution of a digital image is not really the resolution. It is the maximal amount of discriminable points. Image resolution quantifies how close lines can be to each other and still be visibly resolved. The term resolution is often used for a pixel count in digital imaging, even though international standards specify that it should not be so used. None of the pixel resolutions are true resolutions, but they are widely referred to as such.

**Conclusion**

We have extended the commonly used term resolution to the other terms described in the article. The evidence of our efforts, we have shown the contributions to appropriate method to further develop and continue further research that could accurately measure and distinguish signal from noise, but also prospectively to find patterns in the actual noise.

**Acknowledgement**

The authors thank to our students Jan Bayram, Lucie Kačeriaková, and Kristýna Vrbová. This project was supported and co-financed by the project Postdok JU CZ.1.07/2.3.00/30.0006; by the South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenoses CENAKVA CZ.1.05/2.1.00/01.0024; and by the South Bohemia University grant Selected complexity phenomena in condensed phase:experiment, development and theory GA JU 134/2013/Z (in part).

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