THE VISUAL INTERPRETATION OF REMOTE SENSING DATA

Abstract

The ability to recognise objects in aerial and satellite photographs can be explained as follows: From knowledge of a landscape and its depiction, interpretation rules are developed to assign predetermined meanings to certain combinations of image properties, such as colour, form, size, texture or context. Where it is not decisive that recognition be based on fixed perception patterns, a question arises – and is to date still unanswered – as to a method satisfying scientific criteria to acquire the cognitive correlations between the sensory perceptions.

Experience with visual puns and optical illusions leads to the question as to the fixed element in the visual interpretation of remote sensing data. Galileo's answer, namely to take measured values as the starting point for natural-scientific knowledge, fails to solve the ambiguities and uncertainties of cognitive interpretation, as each number is already assigned a cognitive definition of its meaning: apples, pears, altitude differences… It is thus necessary to specify a different starting point for the conceptual interpretation of perceptions: Man cannot observe or perceive without cognitively acquiring and ordering his experiences, but sensory perception is similarly not a subjective and exclusively personal experience detached from the object. Perception is realised as a unity of the perceiver and the perceived. Consequently, there can be no binary distinction between objective fact and subjective interpretation. Perception takes place between the poles of pure sensation and factual thought free of sensibility. Of the various elements of the process of recognition, the pure discerned qualities of sensory experiences (hot, cold, bright, rough) are the least dependent on subjective, cognitive interpretation. This relationship between observation and cognitive interpretation is reflected in a phenomenological investigation approach, according to which experiences, as absolute elements of perception, gain primary significance and cognitive interpretations become dependent. Thus, the results of phenomenological studies are given preference in the investigation. The author's treatment of the topic also assumes a consistently empirical position.

To understand a situation, it is not sufficient to remain with sensory experiences, because the cognitive correlation for their understanding is lacking – the experiences need to be interpreted conceptually. The dual role of the concepts is here of decisive significance: In analysis, they define limits within the overall field of experience for partial aspects, but at the same time found a synthesis in which these aspects are linked cognitively into a whole. This function of concepts is exploited to differentiate between recognition and the formation of understanding: The interpretation of experience on the basis of a priori defined patterns is aimed at recognition. By contrast, understanding emerges from the observations in a process of concept formation: The initial search is for a subdivision which allows a cognitive synthesis to appear plausible.

The concept of self-organisation has for the most part superseded mechanistic views in ecology, and has also gained inroads in technology in the last decade. In the words of this concept, concept formation can be described as a process of knowledge-building in which cognitive and non-cognitive perception organise themselves.

Sensory experiences also hold a dominating position in other approaches to nature. Consequently, Goetheanism, scientific aesthetics and art can contribute to unconditional natural reconnaissance. The close affinity of phenomenology, aesthetics and art enable artistic creativity to be seen as perfection of natural dispositions.
Further relationships arise from the interpretation of topographic or thematic maps, or other visualised spatial data. Parallels and differences are elaborated.

Modern natural sciences are quantitative. It must thus be clarified, what mathematical modelling contributes to the formation of understanding. In this aspect of the study, it is the following idea which goes beyond the well-known usefulness of mathematical models, forecasts and simulations: Mathematics is deemed convincing by way of the logical strictness in its argumentation: Major and minor premises are followed by the conclusion. A method of observation where individual observations are brought into a sequence, such that each can be derived from its predecessor and there are no gaps to interrupt the sequence, would equate to the necessity of mathematical proof. In scientific argumentation, such strict sequences take the place of spontaneous intuition with verification, falsification and corroborating example. Through use of the mathematical method in this way, it is possible to achieve concept formation close to reality.

The aspects of perception, aesthetics, art and mathematics presented so far are summarised in the method of unconditional concept formation. Thus, the principal goal of the investigation, the development of an understanding-oriented observation method based on experience, is achieved. The treatment is continued with application of the developed methods in the following manner on a basic concept of geoinformatics:

For geoinformatics, the concept of space is of fundamental importance. It is thus expedient to investigate this concept under application of the developed method. From a phenomenological point of view, time and space are closely correlated. Both are experienced in motion. If motion is interpreted with the concepts of juxtaposition and succession, this produces knowledge of space and time. In other words: The bodily experienced motion, through interpretation against the concept of space, becomes a perception of successive locations. Depending on the sensory experiences – or more generally: observations – taken as the basis, space acquires different geometric properties. The experiences of the tactual sense establish Euclidean observations. The experiences of space and time are fundamental to the formation of understanding. With the aid of these concepts, experiences can be classified as either simultaneous and parallel or sequential. They permit knowledge to be formed by analysis and synthesis.

One essential motive of the investigation is the question as to the formation of knowledge within the framework of visual interpretation. The recognition of objects presents itself as a synaesthetic synthesis of sensory experiences and cognitive elements. Different weighting of the cognitive elements allows two approaches to be distinguished: Firstly, for the recognition of new content, it is of essential importance that the cognitive elements remain subordinate to the non-cognitive sensory experiences, i.e. that they can be modified by the latter. Pre-known concepts are accorded the role of hypotheses. Secondly, for the recognition of known content, the cognitive elements are dominant – image contents are to be assigned meanings on the basis of interpretation properties. The image is here searched for areas with combinations of colour, form, patterns, textures and spatial arrangements which could correspond to the desired concept. Alternatively, the image is searched with a kind of key, to reveal possible coincidence with complete image patterns. This, too, is a form of recognition.

To be able to understand a phenomenon, it is necessary, taking the regularity of the outward form, to discover the correlation serving as the regulatory element for the different embodiments. To this end, a classification of interpretation properties is still not sufficient. Cognitive processing of the visualised representations of the phenomenon supports the establishing of such an ideal correlation, which within the great diversity of natural phenomena depicts the constant from which the individual phenomenon may have evolved. The functions describe
the interactions between the spatial elements, which express themselves in exchanges of energy, material and matter. Wherever spatial arrangement is an expression of functional relationships, visual perception of the spatial relationships supports insight into the objective.

In the conclusions, the visualisation of geodata is characterised as a means to reveal the correlations between the phenomena. The reference to remote sensing leads to the statement that the proposed research strategy can only be applied to a limited extent in the field of remote geo-sensing.

The present document takes the foundations of remote sensing and geoinformatics as its central theme. Starting from the thesis that cognitive relationships mean understanding, importance is attached to cross-referred relationships. This is reflected in numerous footnotes and in the references between concepts at home in the discipline, scientific methodology, art and cognitive science.