

INTERSIZE CORRELATION OF GRAIN OCCURRENCES IN TEXTURES AND ITS APPLICATION TO TEXTURE REGENERATION

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Abstract A novel method of texture characterization, called *intersize correlation* of grain occurrences, is proposed. This idea is based on a model of texture description, called “Primitive, Grain and Point Configuration (PGPC)” texture model. This model assumes that a texture is composed by arranging *grains*, which are locally extended objects appearing actually in a texture. The grains in the PGPC model are regarded to be derived from one *primitive* by the homothetic magnification, and the size of grain is defined as the degree of magnification. The intersize correlation is the correlation between the occurrences of grains of different sizes located closely to each other. This is introduced since homothetic grains of different sizes often appear repetitively and the appearance of smaller grains depends on that of larger grains. Estimation methods of the primitive and grain arrangement of a texture are presented. A method of estimating the intersize correlation and its application to texture regeneration are presented with experimental results. The regenerated texture has the same intersize correlation as the original while the global arrangement of large-size grains are completely different. Although the appearance of the resultant texture is globally different from the original, the semi-local appearance in the neighborhood of each large-size grain is preserved.

Keywords: texture, granulometry, skeleton, size distribution

1. Introduction

Texture in the context of image processing is an image structure whose characteristics are given by the size, shape, and arrangement of its parts. Various methods of texture analysis, for example the cooccurrence matrix method and the spatial frequency method, have been proposed [1, 2]. These methods measure global or statistical characteristics of a texture based on its randomness.

Our aim of texture analysis is description, rather than measurement. Texture description assumes a model of texture generation, and estimates the model parameters of a texture and regenerates a new texture whose visual impression is related to the original [3–7]. These methods are based on the random nature of textures.

We have proposed a model of texture description, called “Primitive, Grain and Point Configuration (PGPC)” texture model, and parameter estimation methods based on this model [8]. The PGPC texture model is based on the following observation of the texture suggested by Gestalt psychology: A repetitive appearance of similar objects of a moderate size is organized to be a meaningful structure by the human cognitive process. This observation suggests that a texture is neither completely deterministic nor completely random, but is often locally deterministic and globally random or regular, and that an appropriate texture description model has to be locally deterministic as well as globally deterministic or stochastic. Our model assumes that a texture is composed by arranging *grains* regularly or randomly on an image, and a grain is defined as a locally extended object actually appearing in a texture. The grains in the PGPC model are regarded to be derived from one *primitive* by some shape modifications, since the texture is regarded to be composed by the arrangement of similar small object, as explained in the above observation. The primitive is a model parameter estimated from a texture, and its shape determines local deterministic characteristics of the texture. The grain arrangement determines global, and often stochastic, characteristics of the texture. The primitive and grain arrangement can be estimated using an optimization process based on the granulometry [9, 10] and skeletonization [9, 11].

We propose a novel texture characterization based on the PGPC texture model, called *intersize correlation* of grain occurrences, in this paper. If the modification on the primitive is limited to a homothetic magnification, the *size* of grain is defined as the degree of magnifications. The intersize correlation is the correlation between the occurrences of grains of different sizes located closely to each other. The motivation of introducing the intersize correlation is the observation that the appearance of smaller grains depends on that of larger grains; For example, a large grain is surrounded anisotropically by several smaller grains and the group of these grains appears repetitively. This