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Emrith, K., Chantler, M. J., Green, P. R., Smith, M. and Smith, L. (2010) Human subjectivity to apparent randomness of surface textures. In: *2nd CIE Expert Symposium on Appearance, Gent, Belgium, 8th-10th September, 2010*. Available from: <http://eprints.uwe.ac.uk/12896>

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# Human subjectivity to apparent randomness of surface textures

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People generally categorise information as *random* when they don't find any pattern in it and cannot attribute any meaning. This is generally true when considering sequences of events occurring at given intervals in time where the identification of patterns is used to predict future events (such as market price of stocks). *Randomness* has thus been regarded as a 'special case of structure in information - namely, the case when no structure exists'. However, when it comes to texture images, it is not clear whether 'apparent randomness' is solely characterised by a lack of structural information (e.g. noise surfaces) or otherwise by irregularities in the shape, size, placement and density of texture elements that characterise a surface texture. Additionally, changes in the illumination and viewpoint conditions of a surface also affect its appearance and consequently its apparent randomness [1].

In this paper we investigate the intuitive understanding of humans of apparent randomness in naturalistic textured surfaces rendered under identical viewpoint and illumination conditions. In the first set of experiments we presented observers with pairs of texture images, with every pair differing in only one of two physical attributes mentioned above: (1) varying the degree of phase randomness (or structure) or (2) varying the degree of randomness in the texton placement. The observers were requested to provide upto five words that intuitively described the visual difference between the textures in each pair.

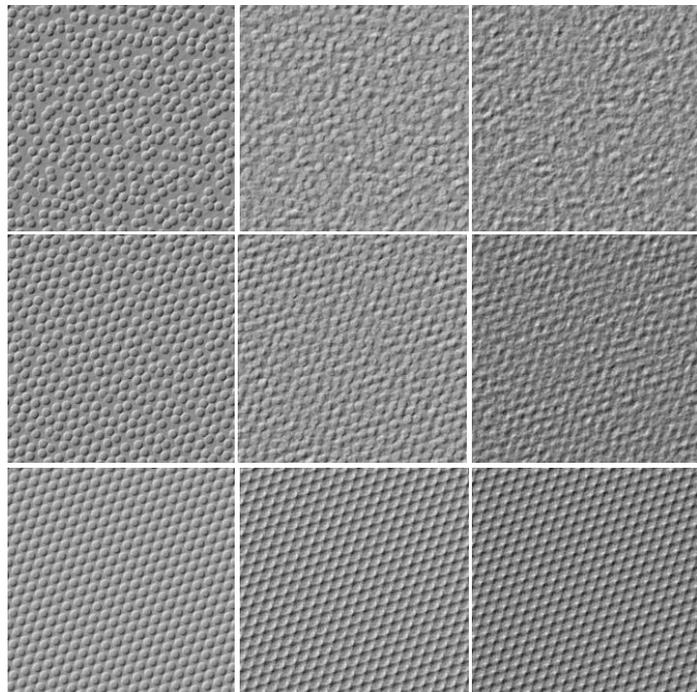


Fig. 1: Appearance matrix, (columns) increasing irregularity in placement of texture elements and (rows) increasing amount of phase distortion.

A 2D *lexical space* (see Fig. 2), derived from the experiment, shows that the words used to describe change in appearance due to randomisation of placement were more aligned than those used to describe change in appearance due to phase randomisation. This suggests that although people are

good at perceiving changes in structural information [2], they would struggle to intuitively communicate this perception (e.g. in the design milieu) as compared to expressing their perception for changes that are due to randomness in placement.

In further experiments we established the association between the words and the perceived differences in the appearance of texture images for different amounts of phase randomisation. Observers were presented with quadruples of texture images and were asked to select the pair with the larger perceptual difference. In addition, observers were asked to select the word that most intuitively represented this difference. A perceptual scale showing the behaviour of humans in performing such a task is derived. Furthermore, an association of words for different degrees of phase randomisation is provided.

The lexical space shows that observers used the word *rough* frequently to describe differences in appearance due to randomisation of both phase and placement attributes. Since all surfaces used in this study were normalised for RMS roughness, this suggests that *perceived roughness* is not only characterised by first and second order statistics [3], but also by the higher order statistics represented by the phase spectrum.

## References

- [1] M. J. Chantler, M. Petrou, A. Penirschke, M. Schmidt, and G. McGunnigle, "Classifying Surface Texture While Simultaneously Estimating Illumination", *International Journal of Computer Vision*, 62, 83-96 (2005).
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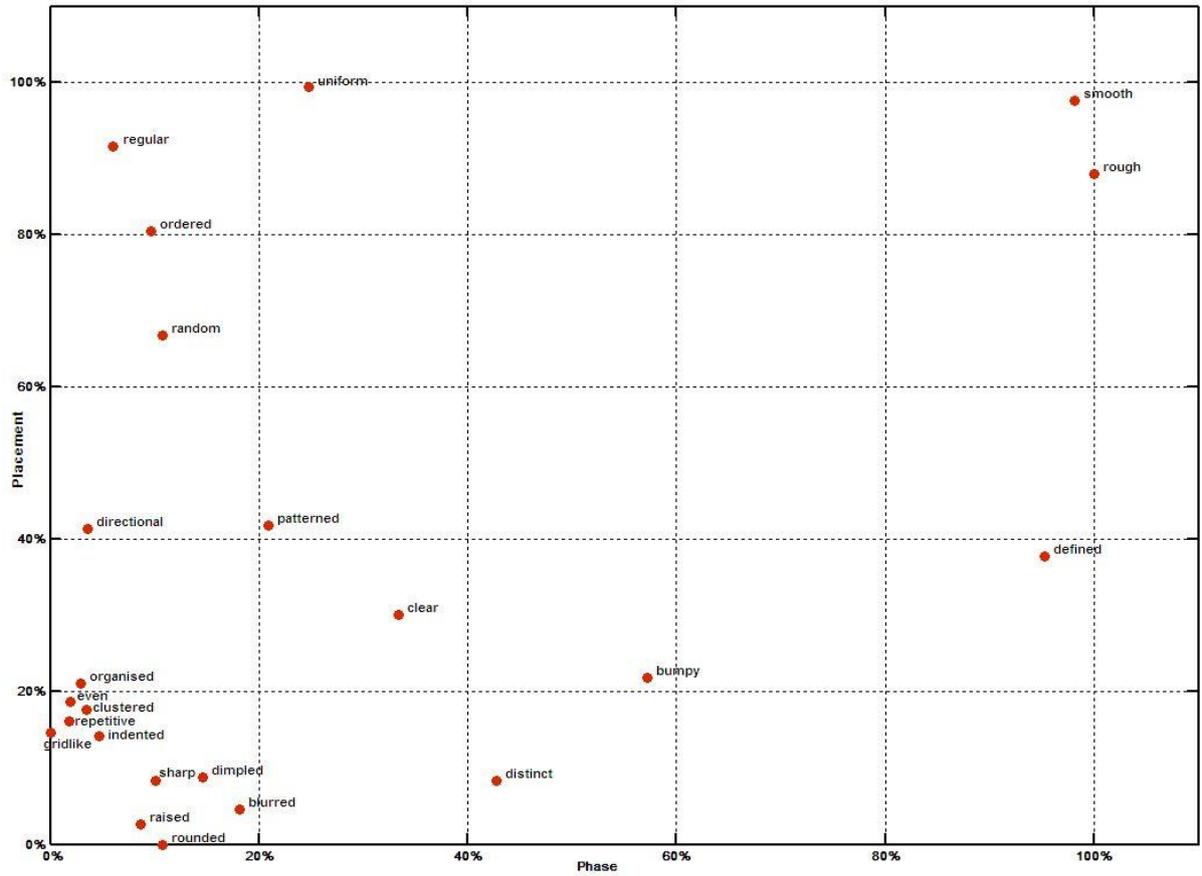


Fig. 2: 2D Lexical Space