

**DIPARTIMENTO DI INGEGNERIA
CORSO DI DOTTORATO IN INGEGNERIA INDUSTRIALE E
DELL'INFORMAZIONE -
PHD COURSE IN INDUSTRIAL AND INFORMATION ENGINEERING -
36TH CYCLE**

Title of the research activity:	Shape, colour and texture features for the analysis of two- and three-dimensional images: methods and applications
State of the Art:	Colour, texture and shape are the visual clues that mostly determine the appearance of objects, materials and scenes. The definition of mathematical models to compute such features in an objective and repeatable manner is crucial in a wide range of applications, as for instance product inspection, object classification, surface grading, content-based multimedia retrieval and computer-assisted medicine. Traditionally the approach to the problem was model-based, with the visual features being designed by hand (hence the term 'hand-crafted'). In recent years, however, research has been shifting towards data-based models (Deep Learning). It is still an open issue, however, how the knowledge from the the mathematical features defined by hand ('engineered') can be integrated with Deep learning models to produce high-performance visual models.
Short description and objectives of the research activity:	The overall objective of this research is to investigate suitable colour, shape and texture analysis methods to extract meaningful from planar and volumetric images. Particular attention will be devoted to a comparative analysis of hand-crafted models and Deep Learning and to the development of methods to integrate the two methodologies. Applications will focus on one or more of the following fields: 1) recognition and characterization of the visual properties of industrial materials; 2) analysis of three-dimensional medical scans for computer-assisted analysis and prognostication and 3) automatic recognition of visual traits in artwork such as author and/or art style/genre.
Bibliography:	<ul style="list-style-type: none"> ▪ Bello-Cerezo, R., Bianconi, F., Di Maria, F., Napoletano, P., and Smeraldi, F. Comparative evaluation of hand-crafted image descriptors vs. off-the-shelf CNN-based features for colour texture classification under ideal and realistic conditions. <i>Applied Sciences</i>, 9(4), February 2019. Article number: 738. ▪ Bianconi, F., Fravolini, M.L., Palumbo, I., Palumbo, B. Shape and Texture Analysis of Radiomic Data for Computer-Assisted Diagnosis and Prognostication: An Overview (2020) <i>Lecture Notes in Mechanical Engineering</i>, pp. 3-14. ▪ Bo, L., Ren, X., Fox, D. Kernel descriptors for visual recognition (2010) <i>Advances in Neural Information Processing Systems 23: 24th Annual Conference on Neural Information Processing Systems 2010, NIPS 2010</i>, 9 p. ▪ Lecun, Y., Bengio, Y. and Hinton, G. Deep learning. <i>Nature</i>, 521(7553):436-444, 2015.
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