DIPARTIMENTO DI INGEGNERIA
CORSO DI DOTTORATO IN INGEGNERIA INDUSTRIALE E DELL'INFORMAZIONE -
PHD COURSE IN INDUSTRIAL AND INFORMATION ENGINEERING - 37TH CYCLE

Title of the research activity:	**Shape and texture features for the analysis of two- and three-dimensional images: methods and applications**
State of the Art:	The definition of mathematical models to compute shape and texture features from planar and volumetric images is central to a number of applications, including product inspection, object classification, surface grading, content-based multimedia retrieval and computer-assisted medicine. Up until not long ago the approach to the problem used to be 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 activity is to investigate suitable shape and texture analysis methods to extract meaningful features from planar and volumetric images. Particular attention will be devoted to the development of descriptors for symmetry. Applications will focus on the following topics: 1. Recognition and characterization of the visual appearance of industrial materials; 2. Analysis of three-dimensional medical scans (e.g. PET, CT and MRI) for computer-assisted diagnosis and prognostication.
Bibliography:	▪ Bianconi, F., Palumbo, I., Spanu, A., Nuvoli, S., Fravolini, M.L., Palumbo, B. PET/CT radiomics in lung cancer: An overview (2020) Applied Sciences (Switzerland), 10 (5), art. no. 1718. ▪ 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. Applied Sciences, 9(4), February 2019. Article number: 738. ▪ Bianconi, F., Cusano, C., Napoletano, P., Schettini, R. CNN-based refactoring of hand-designed filters for texture analysis: A classic revisited (2019) IEEE Access, 7, art. no. 8918055, pp. 173076-173085. ▪ Lecun, Y., Bengio, Y. and Hinton, G. Deep learning. Nature, 521(7553):436–444, 2015. ▪ Yin, X.-X., Ng, B.W.-H., Ramamohanarao, K., Abbott, D. Tensor based sparse decomposition of 3D shape for visual detection of mirror symmetry (2012) Computer Methods and Programs in Biomedicine, 108 (2), pp. 629-643.
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