Tutorial on
Moment Invariants and their Applications in Image Analysis
at
the 5th Indian International Conference on Artificial Intelligence (IICAI-11)
http://www.iiconference.org

Feature extraction is an important image analysis task, and is essential for doing recognition tasks, like image classification, query based image retrieval, etc. Ideally, the set of features should possess good discrimination ability (in order to discriminate between different categories of images) and also generalization ability (in order to derive a generalized model for a class of similar images). Complications arise because the image data depends on, (i) the sensing device (*i.e.,* camera), which can cause addition of random or systematic noise to the data, (ii) lighting conditions (*e.g.,* brightness can vary) and (iii) orientation and distance between the sensed object and camera, because of which, the image contains a transformed version of the real world object, like a rotated or a scaled version.

Preprocessing the image data through various steps, like removing noise, bringing images to a standard average brightness, contrast, etc., and, applying various geometric transformations, like bringing objects present in the image to a standard size, orientation, etc., is one way to deal with the complexity of the problem. After this preprocessing step, features are extracted. This approach is time consuming and error prone. Often this approach is not suitable for time critical applications, especially when dealing with higher dimensional problems, like 3D images, videos, etc.

Moment of a particular order of a function is a descriptor of the function. For example, for a probability distribution function, its first moment is its mean value. There are various types of moments, like, geometric moments, rotational moments, orthogonal moments, complex moments, Zernike moments, Legendre moments, etc. Moment invariants are moments which are insensitive to particular type of degradations or transformations. For example, central and normalized moments are invariant to translation and scaling of object present in a 2D image. Rotational invariants are moments which are invariant to rotation. Radiometric invariants are invariant to radiometric changes, like changes in brightness and contrast.

Moment invariants can be used as features to represent an image and can reduce the preprocessing overhead. Starting from Hu [1], who applied them for 2D object recognition, several other applications were proposed, like, for image registration, for texture classification, for face recognition, for hand-drawn shape recognition, for computer vision applications [2], etc. It has sound theoretical background given by the fundamental theorem of moment invariants [3].

The tutorial will cover, (i) fundamentals of moment invariants, (ii) various moment invariants, their properties and applications, (iii) current state-of-art and (iv) a few future research directions.

REFERENCES

[1] M. K. Hu, "Visual pattern recognition by moment invariants", IRE Trans. Information Theory, vol. 8, pp. 179—187, 1962.

[2] G.A. Papakostas, E.G. Karakasis and D.E. Koulouriotis, "Novel moment invariants for improved classification performance in computer vision applications", Pattern Recognition, vol. 43, issue 1, , pp. 58—68, 2010.

[3] T.H. Reiss, “The revised fundamental theorem of moment invariants, IEEE Trans. Pattern Analysis and Machine Intelligence, vol. 13, no. 8, pp. 830—834, 1991.