

# A RFM Pattern Recognition System Invariant to Rotation, Scale and Translation

Selene Solorza-Calderón<sup>(✉)</sup> and Jonathan Verdugo-Olachea

Facultad de Ciencias, Universidad Autónoma de Baja California,  
Km. 103, Carretera Tijuana-Ensenada, 22860 Ensenada, B.C., México  
selene.solorza@uabc.edu.mx

**Abstract.** In this paper a rotation, scale and translation (RST) invariant pattern recognition digital system based on 1D signatures is proposed. The rotation invariance is obtained using the Radon transform, the scale invariance is achieved by the analytical Fourier-Mellin transform and the translation invariance is realized through the Fourier's amplitude spectrum of the image. Once, the RST invariant Radon-Fourier-Mellin (RFM) image is generated (a 2D RST invariant), the marginal frequencies of that image are used to build a RST invariant 1D signature. The Latin alphabet letters in Arial font style were used to test the system. According with the statistical method of bootstrap the pattern recognition system yields a confidence level at least of 95%.

**Keywords:** Pattern recognition · Radon-Fourier-Mellin Images · 1D RST invariant signature · Radon transform · Analytical Fourier-Mellin transform

## 1 Introduction

In the pattern recognition field, the feature extraction process to generate a descriptor invariant to geometric transformations of the object (translation, rotation, scale, noise, illumination and others) is not a trivial problem. Since the first optical experiments in the middle of last century, the features extraction has been a subject of interest and a great progress were done since the introduction of the classical joint transform correlator by Vander Lugt [1], that is the classical matched filter (CMF). Due to the fact that the CMF filter has low response to additive Gaussian noise other filters were generated, just as the phase-only filter (POF), the synthetic discriminant function filter (SDF) and others. In general, the filters are specialized to solve specific problems, for example the filter could have an excellent performance in the discrimination step and the signal-to-noise ratio but low efficiency under non-homogeneous illumination [2]. Although composite filters are being used, the RST invariant image classification problem is an active field due to its intrinsic complexity[3–7].

Actually, with the great advance in technology, the pattern recognition via digital images is a very productive area. A lot of methodologies in digital images