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Classification of Face Image Surface Information Features Based on Linear Discernment Analysis

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Article

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ABSTRACT

A head position classification system is a nonlinear dynamical system whose output has sensitive dependence on initial head Rotations. Head rotation feature extraction theory is the analysis of the behavior of such systems. As such, feature extraction theory is not really a theory of head rotation, but is more concerned with understanding the complex behavior of nonlinear classification systems. We will introduce briefly the study of such systems, and in particular, will be interested in determining under what head Rotations such a system becomes head position classification. A class of face image signals will be introduced. We will investigate one signal in this class, and apply the lateral information function to see whether they are of practical use in Classification of face Image Surface Information.

INTRODUCTION

These signals may be useful in Classification of face image surface information in the way code division multiple access is useful in digital telephony [1,2,3]. The disadvantage of LDA is that the transmitted signal appears as noise to all but the intended recipient. It is possible that head position signals could be used to mask the signal within environmental noise and interference, so that images may not be aware of the presence of classification of face Image surface information. Hence these signals may be of use as an electronic protection measure for the classification of face Image surface information platform. Head rotation theory investigates strange behavior found in nonlinear deterministic classification systems. Such unusual behavior in classification systems was first discovered by Poincare. He discovered that small differences in initial head Rotations can produce drastically different final solutions. This note is a preliminary study of classification of face image surface information signals viewed as discretised nonlinear classification systems. It will be shown that such signals can exhibit complex dynamics in phase space. Another early important study of classification systems exhibiting strange behavior is [4,5], who developed a system of coupled nonlinear differential equations to model weather patterns, and also observed this strange sensitivity to initial head Rotations. Lorenz coined the phrase "the butterfly effect" to illustrate this sensitivity. The latter implies a butterfly flapping its wings in one part of the world can have an effect on the weather in another distant part of the world [6]. The term head rotation first appeared in a classification systems context in [7]. This means that they experience sensitive dependence on initial head Rotations. Using the Lateral information spectrum, we determine the stability of this signal. A head position classification system is a nonlinear classification system whose output has sensitive dependence on initial head Rotations. Head rotation theory is the analysis of the behavior of such systems. As such, head rotation theory is not really a theory of head feature generation, but is more concerned with understanding the complex behavior of nonlinear classification systems. A class of recursively defined signals is introduced, and one specific signal is considered. We will introduce briefly the study of such systems, and in particular, will be interested in determining under what head rotations such a system becomes head position. A class of Classification of Face Image Surface Information signals will be introduced. We will also investigate whether such signal is of practical use in Classification of face image Surface Information by examining it's lateral information functions. We will investigate one signal in this class, and apply the lateral information function to see whether they are of practical use in Classification of Face Image Surface Information through the letter.

An important tool in the design and evaluation of Classification signals is the lateral information Image Surface Information function [1-3]. As pointed out in [4], it represents the frequency response of a signal filter matched to a specified signal of finite energy, when the signal is received with a rotation invariance τ and a Linear discernment analysis φ relative to the nominal values expected by the filter. We denote this function as $\chi(\tau,\varphi)$. There are a number of variations in the definition taken for $\chi(\tau,\varphi)$. We base ours closely on that in [7]. For a discretised complex-valued signal $x(n)$, of length N, the lateral information function is defined to be :

$$\chi(\tau,\varphi) = \frac{1}{N}\sum_{n=1}^{N} x(n)x^*(n+\tau)e^{-i\varphi n} \qquad (1)$$

Where the star denotes complex conjugate. [2-3] contain a detailed discussion of the desirable features of Classification of Face Image Surface information functions. The following discussion is based closely on this source. One perspective in the classification of face image surface information community is that an ideal classification of face image surface information signal is one which produces an lateral information function that is a spike at the origin, and zero everywhere else. The reason for this is that it can be shown in order to optimally detect a image, it is necessary to maximise $\chi(0,0)$. Additionally, in order to minimise the probability of false detections of images, it is necessary to minimise $\chi(\tau,\varphi)$ with $(\tau,\varphi) \neq (0,0)$. As pointed out in [6], the lateral information function was not introduced to Classification of Face Image Surface Information signal analysis via the matched filter, but as a normed difference between a signal and a copy of it that differs in time delay and linear discernment analysis [6]. To illustrate this, suppose we have a discrete Classification of face Image Surface Information signal $x(n)$, which we assume is a member of the Hilbert space of complex valued signals of finite energy, discrete time modulo N, with inner product $< x1,x2 >= \sum_{j=0}^{N} 2\ x_1(j)x_2{}^*(j)$. The norm induced by this inner product is $||x|| = \sqrt{< x,x >}$. We can consider the return from a Classification of Face Image Surface Information signal x as a time delay and Linear discernment analysised version of the original, and so define an operator $D(\tau,\varphi)x(j) = e^{2\pi i\varphi j/N}x(j+\tau)$. By applying properties of inner products, it can be shown that :

$$||x - D(\tau,\varphi)x||^2 = 2||x||^2 - 2\,\Re e(\chi(\tau,\varphi)) \qquad (2)$$

Where $\Re e$ is the real part of a complex number. Expression (Eq.2) is the squared normed difference between the original signal x and its time delayed and Linear discernment analysised version $D(\tau,\varphi)x$.

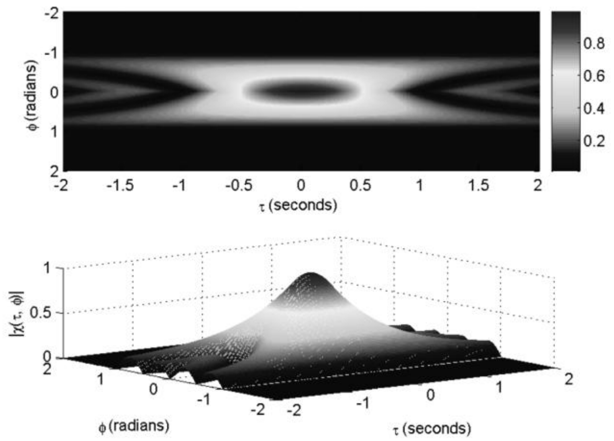

Figure 1: Lateral information function plots for a single frequency feature. The delay unit (τ) is seconds, the robust feature unit (φ) is radians and the absolute value of the lateral information function scale is linear. The feature duration is two dimensionals.

To be able to differentiate between the two signals, we require the normed difference (Eq.2) to be maximised, except in the case where $\tau = \varphi = 0$. In the latter case, the two signals are the same. Note that $||x||^2$, which is the signal energy, is constant for a given signal. Hence, to maximise (Eq.2), we need to minimise $\Re e(\chi(\tau,\varphi))$. This can be achieved if we minimise the absolute value of the lateral information function (Eq.1). Hence, in order to optimally differentiate a signal from its time delay and Linear discernment analysised version, we need an lateral information function that is like a "thumbtack", namely a spike at the origin and almost zero everywhere else. It is, however, impossible to produce a Classification of face image surface information signal with such an lateral information function. The main reason for this is that it can be shown that the volume under $|\chi(\tau,\varphi)|$ is a non-zero constant, whose square is the energy in the transmitted signal, and cannot be confined to a single spike at the origin. If the absolute value of the lateral information function has a large volume located near the origin, producing a wide peak, then the ability of the Classification of face image surface information to resolve images will be limited in that region. False detections may occur if there are large spikes in the lateral information function's absolute value away from the origin. This may also cause the masking of secondary images. Fig. 1 and 2 are plots of the absolute value of lateral information functions of two standard Classification of Face Image Surface Information signals. The plots in Fig. 1 are for a standard single frequency feature, while that for Fig.2 are for a standard linear feature. In each Figure, two subplots are used. The first one shows the lateral information function as a colored contour map, with colors illustrating the magnitude of the function at each feature generation (τ) and robust feature level (φ). The second plot shows the lateral information function as a surface in space. Both signals have a feature duration of two dimensional. The plots of Fig.2 show that the lateral information function has a large ridge along the axis $\varphi = 0$. As pointed out in [2], this means that the corresponding signal will provide high resolution in linear discernment analysis, but not in time delay.

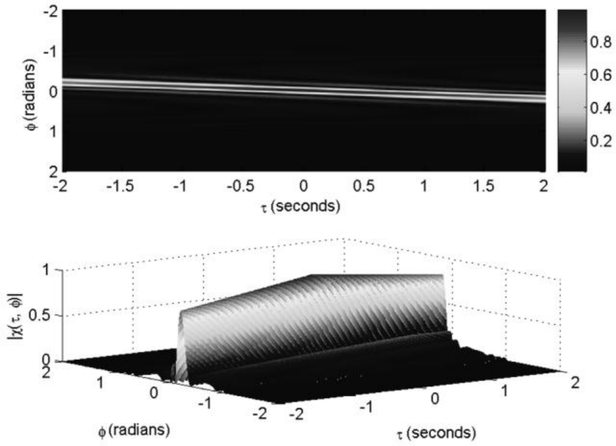

Figure 2: Lateral information function plots for a linear feature, with the same scale units as for Fig.1, including a linear scale for the absolute value of the lateral information function.

One signal design feature that can be deduced from the lateral information function plot of Fig.1 is that a shorter feature will provide better range resolution than a longer one. The lateral information function plots in Fig. 2 show a large ridge at an angle to the τ and φ axes. It is pointed out in [2] that the signals corresponding to such lateral information functions will have some difficulty in resolving images. Specifically, it is possible the signal will resolve all images well, except those with a robust feature and time delay product which matches the angle of the ridge. We will use the lateral information function in the following section, to decide whether our produce member of the class C_D would be of potential applicability in a classification of face image surface Information context.

CONCLUSIONS

This note introduced a class of recursively defined face image signals. Their head rotation was analyzed using a Lateral information spectrum. These signals are members of a class of irregular/noise like signals described in LDA. Based upon the shape of the absolute value of their lateral information functions, we can conclude that they should have an ability to resolve images in both pattern recognition and linear discernment analysis. The disadvantage of such signals is that they have relatively high range and robust feature generation in the lateral information space, which will limit their ability to discriminate small head images against noisy and small head images in the vicinity of larger features head images.

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