DIRECTIONAL TIME-FREQUENCY ANALYSIS WITH APPLICATIONS

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ABSTRACT

The purpose of this dissertation is to introduce a new directionally-sensitive time-frequency representation of a function. It is shown that we may break up a function (or signal) into individual time-frequency-direction pieces. A certain coefficient ($\langle f, G_{m,t,u} \rangle$) will allow one to see "how much" frequency is in the function (i.e. signal, image, etc.) in a certain time interval, and also in a certain direction. This has been done using wavelets (ridgelets) and this dissertation introduces a similar concept using time-frequency (Gabor) elements. For such elements, a Parseval formula and a continous frame-type representation together with boundedness properties of a semi-discrete frame operator are obtained. New spaces of functions are also presented which are tailored to fit our time-frequency-direction analysis. Applications relating to image processing and medical imaging are also presented along with development of some algorithms.