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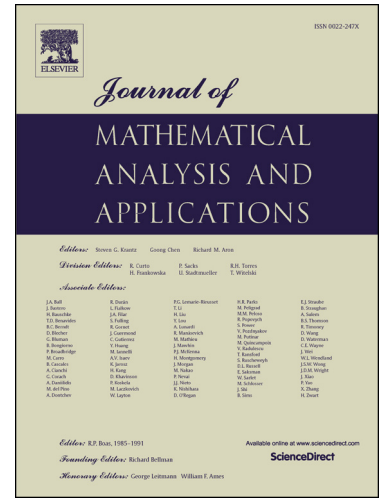
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Dynamical sampling and frame representations with bounded operators

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Abstract

The purpose of this paper is to study frames for a Hilbert space \mathcal{H} , having the form $\{T^n\varphi\}_{n=0}^{\infty}$ for some $\varphi \in \mathcal{H}$ and an operator $T : \mathcal{H} \rightarrow \mathcal{H}$. We characterize the frames that have such a representation for a bounded operator T , and discuss the properties of this operator. In particular, we prove that the image chain of T has finite length N in the overcomplete case; furthermore $\{T^n\varphi\}_{n=0}^{\infty}$ has the very particular property that $\{T^n\varphi\}_{n=0}^{N-1} \cup \{T^n\varphi\}_{n=N+\ell}^{\infty}$ is a frame for \mathcal{H} for all $\ell \in \mathbb{N}_0$. We also prove that frames of the form $\{T^n\varphi\}_{n=0}^{\infty}$ are sensitive to the ordering of the elements and to norm-perturbations of the generator φ and the operator T . On the other hand positive stability results are obtained by considering perturbations of the generator φ belonging to an invariant subspace on which T is a contraction.

1 Introduction

Let \mathcal{H} denote a separable Hilbert space. A frame is a collection of vectors in \mathcal{H} that allows each $f \in \mathcal{H}$ to be expanded as an (infinite) linear combination of the frame elements. Dynamical sampling, as introduced in [2] by Aldroubi et al., deals with frame properties of sequences of the form $\{T^n\varphi\}_{n=0}^{\infty}$, where $T : \mathcal{H} \rightarrow \mathcal{H}$ belongs to certain classes of linear operators and $\varphi \in \mathcal{H}$; for example, the diagonalizable normal operators T that lead to a frame for a certain choice of φ are characterized. Further references to dynamical sampling include [2, 3, 4, 5, 13, 1, 7, 8].

In this paper we consider the general question of characterizing the frames $\{f_k\}_{k=1}^{\infty}$ for which a representation of the form $\{T^n\varphi\}_{n=0}^{\infty}$ with a bounded operator $T : \mathcal{H} \rightarrow \mathcal{H}$ exists. While a representation $\{T^n\varphi\}_{n=0}^{\infty}$ is available for

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