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A Variant of Projection-Regularization Method for ill-posed linear operator equations

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In the present paper, we report on a strategy for computing the numerical approximate solution for a class of ill-posed operator equations in Hilbert spaces: $\mathbf{K} : E \rightarrow F$, $\mathbf{K}f = g$. This approach is a combination of Tikhonov regularization method and the finite rank approximation of $\mathbf{K}^*\mathbf{K}$. Finally, numerical results are given to show the effectiveness of this method.

Keywords: First kind Fredholm integral equations, Ill-posed problems, Finite rank approximation, Tikhonov regularization.

1. Introduction and position of the problem

Let E and F be infinite-dimensional separable Hilbert spaces over \mathbb{R} . In this article, we consider the operator equation of the first kind

$$\mathbf{K}f = g, \quad (1)$$

where $\mathbf{K} : E \rightarrow F$ is compact with infinite rank. $g \in F$ is a given function and $f \in E$ is the unknown function to be determined. In this case, it is well-known that $\overline{\mathcal{R}(\mathbf{K})} \neq \mathcal{R}(\mathbf{K})$, and so the inverse of \mathbf{K} , $\mathbf{K}^{-1} : \mathcal{R}(\mathbf{K}) \rightarrow E$ (if \mathbf{K} is injective)