



## FOURIER ANALYSIS IN SPACES OF SHIFTS

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### Abstract

In this paper, we develop a continual analog of decomposition over orthogonal bases in spaces generated by equidistant shifts of a single function. By doing so, we obtain an explicit expression for the best approximation by spaces of shifts in  $L_p(\mathbb{R})$ . The result is formulated in terms of classical Fourier transform and tends to have various applications in approximation by spaces of shifts and, in particular, in spline approximation.

**Keywords** Spaces of shifts · The best approximation · Fourier transform

**2010 Mathematics subject classification** 42A38 · 41A30

### Notation

In what follows,  $\mathbb{R}$ ,  $\mathbb{Z}$ ,  $\mathbb{Z}_+$ , and  $\mathbb{N}$  are the sets of real, integer, non-negative integer, and natural numbers, respectively. Unless otherwise follows from the context, all the functional spaces under consideration can be real or complex.

If  $p \in [1, +\infty)$ ,  $L_p(\mathbb{R})$  is the space of measurable,  $p$ -integrable on  $\mathbb{R}$  functions;  $L_\infty(\mathbb{R})$  is the space of essentially bounded functions on  $\mathbb{R}$ . The norms in these spaces are defined by

$$\|f\|_{L_p(\mathbb{R})} = \left( \int_{\mathbb{R}} |f|^p \right)^{1/p}, \quad \|f\|_{L_\infty(\mathbb{R})} = \operatorname{vrai\,sup}_{\mathbb{R}} |f|,$$

respectively. The spaces  $L_p[a, b]$  are defined similarly. Furthermore, for  $p \in [1, +\infty)$ , let  $\ell_p(\mathbb{Z})$  be the space of two-sided sequences  $\alpha = \{\alpha_k\}_{k \in \mathbb{Z}}$  for which  $\|\alpha\|_{\ell_p(\mathbb{Z})} = \left( \sum_{k \in \mathbb{Z}} |\alpha_k|^p \right)^{1/p} < +\infty$ .

The space of compactly supported infinitely differentiable functions on  $\mathbb{R}$  is denoted by  $C_0^{(\infty)}(\mathbb{R})$ .

The symbol  $(\cdot, \cdot)_{\mathcal{H}}$  denotes the inner product in the Hilbert space  $\mathcal{H}$ :

$$E(f, \mathfrak{R})_p = \inf_{T \in \mathfrak{R}} \|f - T\|_p$$

is the best approximation of  $f$  in  $L_p$  by the set  $\mathfrak{R} \subset L_p$ .

The Fourier transform of the function  $f \in L_1(\mathbb{R})$  is defined by the formula

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# Topics In Fourier Analysis And Function Spaces

**J Elliott**



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