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Operators resulting from the Dirichlet series

I will discuss a representation of the Dirichlet series in the form of infinite matrices, and its applications to the numerical and theoretical analysis of signals and operators. In particular, this structure plays a role in the construction of bases for $L_2[0, 2\pi]$ given by a set of dilated functions $\{f(nt) : n = 1, 2, \ldots\}$. Systems of dilated functions were investigated by A. Beurling in the 1940s and, after a long intermission, again in the 1990s in a paper by H. Hedenmalm, P. Lindqvist, and K. Seip. The Dirichlet-series matrix approach, on the other hand, was introduced quite recently, first in the context of nonlinear eigenvalue problems. It sheds new light at the analytic properties of these special bases. It also reveals that the corresponding basis transforms have an uncommon property of being numerically implementable via a lifting schema with $O(N \log N)$ efficiency. It is worthwhile mentioning that the connection of some such bases with the nonlinear oscillators indicates their strong applicability to the analysis of a plethora of signals, including signals characteristic for nanoelectronics. In addition, I will discuss an application of the Dirichlet-series matrices to the representation, analysis, and numerical manipulation of a broader class of operators.