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Wavelet and tent space characterizations of $h^p(\mathbb{R}^n)$ and maximal admissible functions for Goldberg splittings

We present a two-part study of the local Hardy spaces $h^p(\mathbb{R}^n)$, $0 < p \leq 1$. The first part gives wavelet and tent space characterizations of h^p through a sequence space t_p on pairs of coefficients, a father layer on the unit lattice and a mother layer on the dyadic cubes. An exact isometric compression maps the tent space T_p into t_p. The characterization comes with an atomic decomposition and with exact L^2 convergence of the wavelet expansion. The second part asks which functions can serve in Goldberg-type splittings of h^p. We determine the maximal admissible class along three axes, regularity, decay and cancellation, and show that the endpoints are sharp. The proof rests on a molecular theory at critical decay, where a logarithmic approximate-cancellation condition appears at the critical moment order, and we prove that its rate cannot be improved. When $p = 1$ no regularity is required.