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On Haar frames in Sobolev type spaces

We study the behavior of the Haar system in Besov and Triebel-Lizorkin spaces on the real line for a parameter range in which unconditionality does not hold. First, we obtain a range of parameters, extending up to smoothness $s < 1$, in which the spaces $F_{p,q}^s$ and $B_{p,q}^s$ are characterized in terms of doubly oversampled Haar coefficients. Secondly, in the case that $1/p < s < 1$ and $f \in B_{p,q}^s$, we actually prove that the usual Haar coefficient norm, $\|\{2^j \langle f, h_{j,\mu} \rangle\}_{j,\mu}\|_{b_{p,q}^s}$ remains equivalent to $\|f\|_{B_{p,q}^s}$. At the endpoint case $s = 1$ and $q = \infty$, we show that such an expression gives an equivalent norm for the Sobolev space W_p^1 , $1 < p < \infty$, which is related to a classical result by Bočkarëv. Finally, in various endpoint cases we clarify the relation between dyadic and standard Besov and Triebel-Lizorkin spaces.

This is joint work with G. Garrigos and A. Seeger.