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Some mapping properties of the Fourier transform

We investigate mapping properties of the Fourier transform acting between fractional Sobolev $H_p^s(\mathbb{R}^d)$ and Besov spaces $B_{p,p}^s(\mathbb{R}^d)$ with the same integrability index p and different smoothness parameter s. We are looking for necessary and sufficient conditions that guarantee continuity, compactness or nuclearity of the transform. The lower bound for the smoothness s_1 of the source space and the upper bound for the smoothness s_2 of the target space are given for the properties to be satisfied. They depend on p. If the smoothness s_1 is smaller than the bound or s_2 is larger, then the corresponding property does not hold. If $p = 2$, then both bounds for continuity of the transform are equal to zero, which coincides essentially with the Plancherel theorem. We also give some description of the asymptotic behaviour of entropy and approximation numbers in case of the compactness of the transform.

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