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<tr><th>abstract</th><td>This paper proves that the approximation of pointwise derivatives of order s of functions in Sobolev space $W_2^m(\R^d)$ by linear combinations of function values cannot have a convergence rate better than $m-s-d/2$, no matter how many nodes are used for approximation and where they are placed. These convergence rates are attained by {\em scalable} approximations that are exact on polynomials of order at least $\lfloor m-d/2\rfloor +1$, proving that the rates are optimal for given $m,\,s,$ and d. And, for a fixed node set $X\subset\R^d$, the convergence rate in any Sobolev space $W_2^m(\Omega)$ cannot be better than $q-s$ where q is the maximal possible order of polynomial exactness of approximations based on X, no matter how large m is. In particular,scalable stencil constructions via polyharmonic kernels are shown to realize the optimal convergence rates, and good approximations of their error in Sobolev space can be calculated via their error in Beppo-Levi spaces. This allows to construct near-optimal stencils in Sobolev spaces stably and efficiently, for use in meshless methods to solve partial differential equations via generalized finite differences (RBF-FD). Numerical examples are included for illustration.</td></tr>
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