A similar recursive approach would work for the ℓ^p norm of $\mathbf{x}$, where $p \geq 1$ and

$$\|\mathbf{x}\|_p = \left(\sum_{i=1}^{n} |x_i|^p \right)^{1/p},$$

if a function $\mathrm{norm}p(x, y)$ were available, where

$$\mathrm{norm}p(x, y) = (|x|^p + |y|^p)^{1/p},$$

such that unwarranted under/over-flows are avoided, and relative accuracy and monotonicity with respect to $|x|$ and $|y|$ are guaranteed.

For $p = 1$, $\mathrm{norm1}(x, y) = |x| + |y|$, for $p = 2$, $\mathrm{norm2}(x, y) = \mathrm{hypot}(x, y)$. Else, as the first attempt,

$$\mathrm{norm}p(x, y) = M\,(1 + q^p)^{1/p}, \quad M = \max\{|x|, |y|\}, \quad m = \min\{|x|, |y|\}, \quad q = m/M \text{ or } 0 \text{ if } m = 0.$$

Let $z = q^{p/2}$. Then $1 + q^p = 1 + z^2 \approx \mathrm{fma}(z, z, 1)$. With cr_pow, the algorithm might be as follows:

$$X = \mathrm{fabs}(x), \quad Y = \mathrm{fabs}(y);$$

$$M = \mathrm{fmax}(X, Y), \quad m = \mathrm{fmin}(X, Y);$$

$$q = m/M, \quad Q = \mathrm{fmax}(q, 0);$$

$$z = \mathrm{cr\_pow}(Q, p/2), \quad Z = \mathrm{fma}(z, z, 1);$$

$$C = \mathrm{cr\_pow}(Z, 1/p);$$

$$\mathrm{norm}p(x, y) \approx M \cdot C.$$