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New minimal set of the spherical bipolar harmonics

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In many applications one has to deal with functions that depend on two directions. In this case a convenient basis for function expansion is provided by bipolar harmonics that are given by irreducible tensor product of the spherical functions with different arguments. The basis of biharmonic functions is overcomplete for a fixed total angular momentum and for arbitrary internal angular momenta.
Very often bipolar harmonics with a small rank of total momentum enter the final results while the ranks of the internal tensors can run over a wide (or infinite) range. But it is possible to decompose the bipolar harmonic using the smallest set of internal orbital momenta for a fixed total momentum.
Here we apply the new method for calculations of decomposition coefficients at low values of total angular momenta and arbitrary values of internal momenta, which is not related with the special choice of a coordinate system. Then the basis functions from the minimal set are modified in two respects. 1) All dependence on angle between two directions in bipolar harmonica will be contained only in expansion coefficients and basis functions are independent of this angle. 2) The new basis will be orthogonal and have the same normalization. We can call these tensors as the normalized orthogonal bases from the minimal set of bipolar harmonics. The new basis and expansion coefficients for the low values of total orbital momentum are presented explicitly.

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