Combinatorics of Harmonic Polynomials

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The space of totally harmonic polynomials in n variables (for the symmetric group) is "classically" defined as the set of solutions $y(x)$ to the system of PDE's:

$$\sum_{i=1}^{n} \partial_{x_i}^k y(x) = 0, \qquad 1 \leq k \leq n.$$

We recall an explicit description of this solution set before introducing the notion of diagonally harmonic polynomials. As we will see, this gives rise to many combinatorial problems.