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Toward a basis of diagonal harmonic alternants

The space of diagonal harmonic alternants is $\text{HA}_n = C[E_\lambda \Delta_n[X]]$ where Δ_n is the vandermonde determinant, $E_k = \sum y_i \partial_{x_i}$ and $E_\lambda = E_{\lambda_1} E_{\lambda_2} \cdots E_{\lambda_\ell}$. This space is naturally bigraded by $\binom{n}{2} - |\lambda|$ and $\ell(\lambda)$. It is known that the dimension of HA_n is the Catalan number C_n . In fact even the bi-graded dimension of HA_n is known as the q - t -Catalan number $C_n(q, t)$. Yet, no explicit basis is known for this space.

We construct an explicit basis of certain graded components of HA_n that is valid as long as $n > |\lambda|$.