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On the Evaluation of Sums of Exponentiated Multiples of Generalized Catalan Number Linear Combinations Using a Hypergeometric Approach,

Abstract

Infinite series comprising exponentiated multiples of p-term linear combinations of Catalan numbers arise naturally from a related power series expansion for $\sin(2p\alpha)$ (in odd powers of $\sin(\alpha)$) which itself has an interesting history. In this article some explicit results generated previously by the author (for $p = 1, 2, 3$) are discussed in the context of this general problem of series summation, and new evaluations made for the cases $p = 4, 5$ by way of further examples. A powerful hypergeometric approach is adopted which offers, from the analytical formulation developed, a means to achieve these particular evaluations and in principle many others for even greater values of p.