Mathematics > Combinatorics

On twin and anti-twin words in the support of the free Lie algebra

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Let $L_{K}(A)$ be the free Lie algebra on a finite alphabet A over a commutative ring K with unity. For a word u in the free monoid A^{*} let $\tilde{u}$ denote its reversal. Two words in A^{*} are called twin (resp. anti-twin) if they appear with equal (resp. opposite) coefficients in each Lie polynomial. Let l denote the left-normed Lie bracketing and λ be its adjoint map with respect to the canonical scalar product on the corresponding free associative algebra. Studying the kernel of λ and using several techniques from combinatorics on words and the shuffle algebra, we show that when K is of characteristic zero two words u and v of common length n that lie in the support of ${\mathcal L}_{K}(A)$ - i.e., they are neither powers a^{n} of letters $a \in A$ with exponent $n > 1$ nor palindromes of even length - are twin (resp. anti-twin) if and only if $u = v$ or $u = \tilde{v}$ and n is odd (resp. $u = \tilde{v}$ and n is even).

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