Mathematics > Rings and Algebras

Thin Hessenberg Pairs and Double Vandermonde Matrices

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A square matrix is called {\it Hessenberg} whenever each entry below the subdiagonal is zero and each entry on the subdiagonal is nonzero. Let V denote a nonzero finite-dimensional vector space over a field $\fld$. We consider an ordered pair of linear transformations $A: V \rightarrow V$ and $A^*: V \rightarrow V$ which satisfy both (i), (ii) below. (i) There exists a basis for V with respect to which the matrix representing A is Hessenberg and the matrix representing A^* is diagonal. (ii) There exists a basis for V with respect to which the matrix representing A is diagonal and the matrix representing A^* is Hessenberg.
\noindent We call such a pair a {\it thin Hessenberg pair} (or {\it TH pair}). By the {\it diameter} of the pair we mean the dimension of V minus one. There is an "oriented" version of a TH pair called a TH system. In this paper we investigate a connection between TH systems and double Vandermonde matrices. We give a bijection between any two of the following three sets:
\cdot The set of isomorphism classes of TH systems over $\K$ of diameter d.
\cdot The set of normalized west-south Vandermonde systems in $\Mdf$.
\cdot The set of parameter arrays over $\K$ of diameter d. We give a bijection between any two of the following five sets:
\cdot The set of affine isomorphism classes of TH systems over $\K$ of diameter d.
\cdot The set of isomorphism classes of RTH systems over $\K$ of diameter d.
\cdot The set of affine classes of normalized west-south Vandermonde systems in $\Mdf$.
\cdot The set of normalized west-south Vandermonde matrices in $\Mdf$.
\cdot The set of reduced parameter arrays over $\K$ of diameter d.

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