SEMINARIUM
MATEMATYKA DYSKRETNA

wtorek, 12 marca 2013 r. godz. 12.45, s. 304 A3/A4

COMPLEX HADAMARD MATRICES, ALMOST HADAMARD MATRICES AND BALANCED INCOMPLETE BLOCK DESIGNS

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A real square matrix is called *Hadamard* if all its columns (and rows) are mutually orthogonal and all its entries are equal to plus or minus 1. According to the Hadamard conjecture, such matrices exist for $N = 2$ and multiples of 4. Looking for similar constructions for other dimensions one has to relax some assumptions:
a) Allowing for complex entries one introduces "Complex Hadamard Matrices", built of uni-modular entries with arbitrary phases with mutually orthogonal columns (and rows). Such matrices do exist for arbitrary N (e.g. the Fourier matrix F_N) but their classification is complete for $N \leqslant 5$ only - see http://chaos.if.uj.edu.pl/ karol/hadamard
b) Keeping the matrix real (and orthogonal), but allowing the entries to be of a different modulus.

Looking for orthogonal matrices for which the 1-norm is maximal one defines for any N "Almost Hadamard Matrices". For low dimension their structure can be described by balanced incomplete block designs.