Design Theory - Part I

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FLORA BOWDITCH, University of Victoria
Localized Structure in Graph Decompositions

A G-decomposition of K_v is called *balanced* if each vertex of K_v occurs in the same number of copies of G. In 2011, Dukes and Malloch provided an existence theory for balanced G-decompositions of K_v. Shortly afterwards, Bonisoli, Bonvicini, and Rinaldi introduced *degree-* and *orbit-balanced* G-decompositions. In this talk, we will first discuss these three types of balance and give some examples. We will then examine an existence theory for degree- and orbit-balanced G-decompositions of K_v, which can be modelled by coloured loops in G. We will conclude with a brief discussion about decomposing K_v into a family of graphs.

IREN DARIJANI, Memorial University of Newfoundland
k-colourings of star systems

A c-star is a complete bipartite graph $K_{1,c}$. A c-star system of order $n > 1$, $S_c(n)$, is a partition of the edges of the complete graph K_n into c-stars. A c-star system $S_c(n)$ is said to be k-colourable if its vertex set can be partitioned into k sets (called colour classes) such that no c-star is monochromatic. The system $S_c(n)$ is k-chromatic if $S_c(n)$ is k-colourable but is not $(k-1)$-colourable. If $S_c(n)$ is k-chromatic, we say that its chromatic number is k. In this talk, we will discuss some new results of k-colourings of star systems.

PETER DUKES, University of Victoria
Packings of 4-cliques in complete graphs

This talk considers maximum packings of edge-disjoint 4-cliques in the complete graph K_n. When $n \equiv 1, 4 \pmod{12}$, these are simply block designs. When $n \equiv 0, 3 \pmod{12}$, the so-called leave graph induced by uncovered edges is 2-regular. Colbourn and Ling settled the existence of Hamiltonian 2-regular leaves in this case. We extend their construction and use a small batch of seed examples to realize a variety of 2-regular leaves. In fact, we obtain a lower bound on n for the existence of packings with any such leave. This is joint work with Yanxun Chang and Tao Feng.

ESTHER LAMKEN, California Institute of Technology
Constructions and uses of incomplete pairwise balanced designs

I will describe recent work with Peter Dukes on incomplete pairwise balanced designs, IPBD$((v, w), K)$. We provide explicit constructions for such designs whenever v and w satisfy the usual divisibility conditions, have ratio $v/w > k - 1 + \epsilon$, for $k = \min K$ and $\epsilon > 0$, and are sufficiently large (depending on K and ϵ). As a consequence, we obtain new results for several related designs such as IMOLS and GDDs. Of particular interest are the large number of applications that illustrate the power of using IPBDS as templates. I will emphasize these new applications in my talk.