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Neighbour distinguishing edge colourings via the Combinatorial Nullstellensatz

Content :

Consider a simple graph $G=(V,E)$ and its \emph{proper} edge colouring c with the elements of the set $\{1,2,\ldots,k\}$ (or any other k-element set of real numbers). We say that c is \emph{neighbour sum distinguishing} if $\sum_{w\in N_G(v)}c(wv)\neq \sum_{w\in N_G(u)}c(wu)$ for every edge $uv\in E$.
We show that such colouring exists for any graph G containing no isolated edges if only $k\geq 2\Delta(G)+{\rm col}(G)-1$ or $k\geq \Delta(G)+3{\rm col}(G)-4$. The algorithmic proofs of these two facts are based on the Combinatorial Nullstellensatz and inspired by a recent paper of Wong and Zhu
[\emph{Antimagic labelling of vertex weighted graphs}, J. Graph Theory, to appear].
As a consequence, the same number of colours is also sufficient in the well known corresponding problem, where instead of the sums, we wish to distinguish the \emph{sets} of colours met by adjacent vertices.
In fact we consider list versions of the both concepts and prove our assertions in this more general setting.
The second bound implies, e.g., that $k=\Delta(G)+14$ is sufficient for all planar grphs. On the other hand, the corresponding conjectures by Zhang et al. and Flandrin et al. suggest that $k=\Delta(G)+2$ should suffice for all connected graphs of order at least three, except for C_5.

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