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Matrices and their Kirchhoff graphs

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Abstract: The fundamental relationship between matrices over the rational numbers and a newly defined type of graph, a Kirchhoff graph, is established. For a given matrix, a Kirchhoff graph represents the orthogonal complementarity of the null and row spaces of that matrix. A number of basic results are proven, and then a relatively complicated Kirchhoff graph is constructed for a matrix that is the transpose of the stoichiometric matrix for a reaction network for the production of sodium hydroxide from salt. A Kirchhoff graph for a reaction network is a circuit diagram for that reaction network. Finally it is conjectured that there is at least one Kirchhoff graph for any matrix with rational elements, and a process for constructing an incidence matrix for a Kirchhoff graph from a given matrix is discussed.

Math. Subj. Class.: 05C20, 05C50, 05C90

Keywords: Kirchhoff graphs, fundamental theorem of linear algebra, reaction networks.

Matrike in njihovi Kirchhoffovi grafi

Povzetek: V članku je predstavljen temeljni odnos med matrikami nad racionalnimi števili in nedavno definiranim tipom grafa, t.i. Kirchhoffovim grafom. Matriki prirejen Kirchhoffov graf je ortogonalni komplement ničelnega prostora in prostora vrstic te matrike. Najprej dokažemo številne osnovne rezultate, potem pa konstruiramo razmeroma zapleten Kirchhoff graph matrike, ki je transponiranka stoihiometrične matrike, prirejene reakcijskemu omrežju za proizvodnjo natrijevega hidroksida iz soli. Kirchhoffov graf reakcijskega omrežja je krožni diagram za to reakcijsko omrežje. Nazadnje postavimo domnevo, da obstaja vsaj en Kirchhoffov graf za poljubno matriko z racionalnimi elementi, obravnavamo pa tudi proces konstruiranja incidenčne matrike Kirchhoffovega grafa iz dane matrike.

Ključne besede: Kirchhoffovi grafi, osnovni izrek linearne algebre, reakcijska omrežja.