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A comparative study of algorithms for minimal cycle bases for efficient force method of frame analysis

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SUMMARY

A comparative study of different algorithms is presented for the formation of minimal cycle bases of graphs corresponding to sparse cycle-member incidence matrices, leading to the formation of sparse flexibility matrices. These algorithms employ concepts from matroids and theory of graphs. The algorithms are compared using the computational time and storage requirements. Proof is constructed for the minimality of the algorithm developed by the first author, and an efficient approach is employed for its implementation. The algorithms are also compared through examples having different topological properties. Copyright © 2006 John Wiley & Sons, Ltd.

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1. INTRODUCTION

Consider a frame structure S with $M(S)$ members and $N(S)$ nodes, which is $\gamma(S)$ times statically indeterminate. Select $\gamma(S)$-independent unknown forces as redundants. These unknown forces can be chosen from external reactions and/or internal forces of the structure. Denote these redundants by

$$\mathbf{q} = \{q_1, q_2, \ldots, q_{\gamma(S)}\} \tag{1}$$

In order to obtain a statically determinate structure, the constraints corresponding to redundants should be removed. Such a structure is known as the *basic* (*primary or released*) *structure* of S.

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