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A novel approach to the form-finding of membrane structures using dynamic relaxation method

S. Fatemeh Labbafi[1a], S. Reza Sarafrazi[1b], Hossein Gholami[1c] and Thomas H.-K. Kang[*2,3]

[1]*Department of Civil Engineering, University of Birjand, Birjand, Iran*
[2]*Department of Architecture & Architectural Engineering, Seoul National University, Seoul, Korea*
[3]*Department of Civil and Environmental Engineering, University of Illinois at Urbana-Champaign, USA*

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Abstract. Solving a system of linear or non-linear equations is required to analyze any kind of structures. There are many ways to solve a system of equations, and they can be classified as implicit and explicit techniques. The explicit methods eliminate round-off errors and use less memory. The dynamic relaxation method (DR) is one of the powerful and simple explicit processes. The important point is that the DR does not require to store the global stiffness matrix, for which it just uses the residual loads vector. In this paper, a new approach to the DR method is expressed. In this approach, the damping, mass and time steps are similar to those of the traditional method of dynamic relaxation. The difference of this proposed method is focused on the method of calculating the damping. The proposed method is expressed such that the time step is constant, damping is equal to zero except in steps with maximum energy and the concentrated damping can be applied to minimize the energy of system in this step. In this condition, the calculation of damping in all steps is not required. Then the volume of computation is reduced. The DR method for form-finding of membrane structures is employed in this paper. The form-finding of the three plans related to the membrane structures with different loading is considered to investigate the efficiency of the proposed method. The numerical results show that the convergence rate based on the proposed method increases in all cases than other methods.

Keywords: dynamic relaxation method; concentrated damping; form-finding; membrane structures

1. Introduction

Solving system of equations for analysis of every structure is necessary. For this purpose, two ways are available. One of them is repetitive method that is used for linear or nonlinear analysis of structures. Dynamic relaxation method (DR) is one of these iterative methods. The DR is used for analysis of static and dynamic systems. In DR, static systems are converted to artificial dynamic

∗Corresponding author, Associate Professor, E-mail: tkang@snu.ac.kr
[a]Former Master's Student, E-mail: sf.labbafi@yahoo.com
[b]Assistant Professor, E-mail: srsarafrazi@birjand.ac.ir
[c]Former Master's Student, E-mail: hgholami1369@gmail.com

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