A Novel Approach for Impact Load Identification Based on The Cuckoo Optimization Algorithm

M. Arai[1,*] and K. Koyanagi[2]

[1]Department of Mechanical Engineering, Faculty of Engineering, Tokyo University of Science, Tokyo, Japan
e-mail: marai@rs.tus.ac.jp

[2]Graduate School of Engineering, Tokyo University of Science, Tokyo, Japan
e-mails: 4524516@ed.tus.ac.jp

KEYWORDS:*Inverse Problem, Impact Load, Gyro Sensor, Generalized Inverse Matrix, Cuckoo Optimization.*

Ensuring the safety and reliability of structures requires accurate identification of both the magnitude and location of impact loads. In this presentation, we propose a method for estimating these quantities using the Cuckoo Optimization Algorithm (COA) [1] (see Fig. 1). Assuming that the structure undergoes elastic deformation, the temporal variations in the rotational angles measured by wireless gyroscopic sensors mounted on the surface are related to the impact loads through a response matrix equation. The impact location is determined using the COA, while the magnitude of the impact load is computed using the Moore–Penrose generalized inverse [2].

The proposed approach enables efficient identification of both the time history and the location of impact loads without the need for a large number of sensors. To verify its effectiveness, the method was applied to impact problems involving a simply supported beam and a plate. The results confirm that the proposed method can accurately estimate both the magnitude and the location of the applied impact load in these cases.

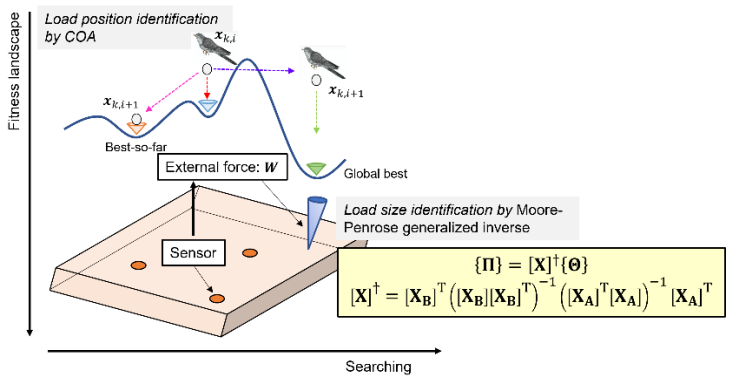

Figure 1. Overview of the proposed load identification method, which uses COA to search for the load position in the fitness landscape and the Moore-Penrose generalized inverse to estimate the load magnitude.

ACKNOWLEDGEMENT: This work was supported by JSPS KAKENHI Grant Number 22K03878. The authors gratefully acknowledge this support.

[1] R. N. Mategna, *Phys. Rev. E*, **49** (5), 4677-4683, 1994. https://doi.org/10.1103/PhysRevE.49.4677.

[2] M. A. Rakha, *Appl. Math. Comput.*, **158** (1), 185-200, 2004. https://doi.org/10.1016/j.amc.2003.09.004.