GRAPH-THEORETIC INSIGHTS INTO THE MOORE-PENROSE INVERSE OF RECTANGULAR FIBONACCI MATRICES WITH CRYPTOLOGICAL APPLICATIONS

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ABSTRACT

Cryptology, one of the key components of modern information security, continues to evolve in response to vulnerabilities in traditional encryption methods. In addition to classical approaches based on algebraic structures or number theoretic principles, the use of interdisciplinary mathematical methods such as graph theory offers innovative possibilities to improve cryptographic security.
This research introduces a novel cryptographic framework that merges the inherent structural characteristics of graph theory with Fibonacci-based matrices and their Moore-Penrose generalized inverses (pseudoinverses), offering a novel approach that exhibits robust resilience against conventional cryptanalysis techniques. The study focuses on strengthening the role of graph theory in cryptography by incorporating concepts such as complete graphs, weighted graphs, and cycles in graphs. Although there are various studies in the literature on the use of the Fibonacci sequence as a cryptographic key, the approach presented here, which combines the Moore-Penrose inverse of the Fibonacci matrix with Graph Theory, introduces a relatively new perspective that has not yet been widely explored in existing research. Thus, a hybrid model is created that incorporates the strengths of both linear algebra and graph theory into the cryptographic process simultaneously. From an information theoretic and computational security perspective, this model stands out by providing a different perspective and an additional layer of protection compared to existing methods.

***K*eywords** Graph Theory · Cryptography · Fibonacci Numbers · Fibonacci Q- matrix · The Moore-Penrose Generalized Inverse

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