



Graph Theory Techniques for Water Resource Allocation in Egypt: Spectral Methods and Condition Number Analysis

Ahmed El-Masry^{1,2}, Nourdin Fouad^{3,4}

¹ Department of Research, Ain Shams University

² Helwan University

³ Department of Interdisciplinary Studies, Ain Shams University

⁴ Department of Advanced Studies, Helwan University

Published: 04 August 2013 | **Received:** 16 March 2013 | **Accepted:** 22 June 2013

Correspondence: aelmasry@hotmail.com

DOI: [10.5281/zenodo.18993661](https://doi.org/10.5281/zenodo.18993661)

Author notes

Ahmed El-Masry is affiliated with Department of Research, Ain Shams University and focuses on Mathematics research in Africa.

Nourdin Fouad is affiliated with Department of Interdisciplinary Studies, Ain Shams University and focuses on Mathematics research in Africa.

Abstract

Graph theory is a powerful tool for modelling complex systems such as water resource allocation networks in Egypt. Spectral methods and condition number analysis provide robust techniques to optimise these systems. We employ spectral clustering algorithms on a network model of water resources, analyse the condition numbers to ensure system stability, and validate our methods using synthetic data reflecting real-world conditions in Egypt. A significant proportion (75%) of spectral clusters identified optimal allocation patterns across different regions, indicating improved resource distribution efficiency compared to traditional methods. Spectral clustering and condition number analysis have been successfully applied to water resource allocation in Egypt, demonstrating their potential for enhancing resource management strategies. Further research should investigate the long-term impacts of these optimization techniques on ecosystem health and socio-economic outcomes in diverse regions of Egypt. graph theory, spectral clustering, condition number analysis, water resource allocation, Egypt The analytical core is $\hat{y} = \mathop{\text{argmin}}_{\theta} L(\theta)$, and convergence is established under standard smoothness conditions.

Keywords: Graph Theory, Network Analysis, Spectral Graph Theory, Condition Number, Optimization Techniques, Complex Networks, Algorithmic Methods

ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

✉ **REQUEST FULL PAPER**

Email: info@parj.africa

Request your copy of the full paper today!

SUBMIT YOUR RESEARCH

Are you a researcher in Africa? We welcome your submissions!

Join our community of African scholars and share your groundbreaking work.

Submit at: app.parj.africa



Scan to visit app.parj.africa

Open Access Scholarship from PARJ

Empowering African Research | Advancing Global Knowledge