

CELLULAR AUTOMATA FOR HEALTHCARE SYSTEM APPLICATIONS USING COMPUTATIONAL MODEL VARIANTS

PUJA RARHI¹, SUTAPA SARKAR^{1*} AND INDRAJIT BANERJEE²

Cellular automata (CA) are suitable for application in various discrete computational models. It can be widely used for simulating complex systems. Over the past decades, CA has emerged as an effective tool for modeling biological and healthcare domain such as disease spread, tumor growth, and defected cell population dynamics with simple local interactions. This review examines the foundations of recent CA applications in healthcare systems. It summarizes the applicability of CA theory to model for rate of spread, epidemiology, medical imaging and other components of healthcare systems derived from a simulation perspective. This work also compares artificial intelligence and machine learning (AIML) with CA models. It's exploring hybrid approaches and the integration of CA with AIML techniques for result improvements in predictive parametric analysis. CA modeling in spatial-temporal behavioural patterns in healthcare is prospective. Therefore, the review draws insights from existing research to identify gaps and future research opportunities for applying CA in healthcare analytics and computational complexity.

computational healthcare simulation and modeling frameworks based on CA have successfully supported both the planning of healthcare systems and public health initiatives¹⁰. Recently, researchers have begun to investigate hybrid models that employ CA in combination with artificial intelligence (AI) algorithms, and optimization techniques to increase the predictive capabilities of CA-based HC systems. In addition, the continued development of CA modeling in concert with the expansion of CA modeling capabilities (e.g., the analysis of very large biomedical data sets; enhancing disease detection; supporting the clinical decision process) has further expanded the role of CA as a methodological tool in modern healthcare research and applications^{2,7}. Overall, CA provides a flexible and robust framework for the modeling of complex health care systems. Not only can CA depict the spatial nature of various interactions, but they can also represent the dynamic nature of healthcare systems, as well as the emergent behaviours associated with those systems. Therefore, CA will continue to be an excellent resource for disease modelling, medical imaging, biomedical signal processing, and optimizing the operation of health care systems.

Conclusion

In healthcare system, CA is a main part of valuable computational approaches for modeling complex. Its ability to simulate spatial and temporal interactions. It makes to useful in disease spread analysis, tumor growth modeling, and medical image processing. Integrating CA with AI and data-driven techniques can further enhance healthcare research, diagnosis, and decision-support systems in modern medical applications. □

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