NSF Highlights

Mathematical modeling uncovers basic DNA packing principles in trypanosomes

Outcome:

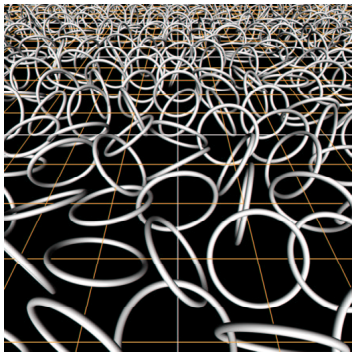
A team of mathematicians from San Francisco State University and the University of North Carolina Charlotte has uncovered new clues to the three dimensional organization of mitochondrial DNA in trypanosomes using mathematical modeling.

Impact/ benefits:

Trypanosomes are parasites responsible for widespread fatal diseases such as sleeping sickness. This neglected disease, transmitted by the tse-tse fly, threatens millions of people in sub-Saharan Africa. Its western counterpart, Chagas disease, affects an estimated 8-11 million people across North and South America. A clearer understanding of the biology of the disease is needed so that effective pharmacological interventions can be developed. Unveiling the intricate organization of DNA in trypanosomes will open new avenues for the design of drugs to prevent and treat these and other diseases. Furthermore the mathematical model developed in this project contributes to our understanding of DNA organization in other organisms and expands our knowledge in biomathematics.

Background/ explanation:

A distinctive feature of trypanosomes is the organization of some of their mitochondrial DNA into a network of several thousand interlocked minicircles. Experimental results have provided models for the organization of the network but have never before been able to offer an explanation for its origin and maintenance. The scientists involved in this study have found that tight packing of minicircles in a small volume is a sufficient condition for forming this network. The finding provides a new approach to understanding how the network is replicated in mitochondrial DNA and therefore how these organisms spread disease.



Graphic Caption: Network of oriented flat minicirles on a square grid. A tightly packed grid yields high levels of interlocking to form a large network of minicircles. This provides a model for the organization of DNA minicircles in the mitochondria of trypanosomes.

Graphic Credit: Javier Arsuaga, San Francisco State University