INNOVATION PARTNERSHIPS
UNIVERSITY OF MICHIGAN

Online Tensor Completion and Tracking of Free Submodules with the t-SVD

TECHNOLOGY NUMBER: 2020-199

OVERVIEW

Efficiently completes missing tensor data using advanced tensor algebra framework

- Significantly faster in processing and memory efficiency than existing tensor methods
- Medical imaging, video processing, and large-scale data analysis

BACKGROUND

The tensor completion problem involves filling in missing entries of multi-dimensional arrays (tensors) and has critical applications in fields like medical imaging, video processing, and collaborative filtering. Historically, matrix completion techniques extended to tensors, but these often struggled with computational inefficiency and large memory demands, especially in streaming data contexts. Traditional batch processing methods necessitate handling the entire dataset at once, resulting in slow performance and difficulty in managing large datasets. Moreover, these approaches do not handle dynamic, evolving datasets effectively, which is a significant limitation in real-time applications. These shortcomings underscore the need for more efficient and adaptive methods. An improved technique is needed to offer real-time processing abilities, manage extensive datasets with resource efficiency, and handle dynamically incomplete data streams with precision.

INNOVATION

The TOUCAN algorithm addresses tensor completion by integrating incremental gradient descent on the Grassmann manifold with the tensor-tensor product and tensor singular value decomposition (t-SVD). This approach allows for processing in linear time with constant memory usage, providing a significant improvement over traditional methods. The innovation lies in TOUCAN's ability to handle highly incomplete and streaming 2-D data, making it incredibly versatile for real-time applications. Its advanced mathematical framework efficiently tracks changes in data, allowing for smooth imputation of missing values as datasets evolve. TOUCAN's potential real-world applications are vast, encompassing fields such as recovering under-sampled temporal MRI data, enhancing video processing by imputing missing frames, and managing large-scale data for analysis in industries reliant on dynamic information feeds. This algorithm offers a robust solution to previously inefficient tensor completion challenges.

Technology ID

2020-199

Category

Software

Software & Content

MOSS - Michigan Open Source Software

Inventor

Kyle Gilman

Laura Balzano

Further information

Ashwathi Iyer

ashwathi@umich.edu

Learn more

ADDITIONAL INFORMATION

PROJECT LINKS:

DEPARTMENT/LAB:

- Laura Balzano, Electrical and Computer Engineering

LICENSE: