

1 Abstract

$$\begin{aligned} Lx &= b \\ x &= L^{-1}b \\ x &= (P + T)^{-1}b \\ x &= (P + USV)^{-1}b \\ x &= (P^{-1} - P^{-1}U(S^{-1} + VP^{-1}U)^{-1}VP^{-1})b \\ x &= P^{-1}b - P^{-1}U(S^{-1} + VP^{-1}U)^{-1}VP^{-1}b \end{aligned}$$

This is the reason I wrote the paper. Novel Algorithm built on Fan Chung graph partitioning for power law graphs. For a class of graphs can give fast inversion for graph laplacian. dont have a great characterization of this class of graphs

2 Introduction

Why is this graph laplacian problem important. Talk about PageRank and other "ranks" ie proteinrank, generank. read as much as i can about neural application. cite it here and mention it in talk.

3 Background

Already written first draft
probably needs a lot more depth in the literature review
probably more papers out there on graph laplacian solvers besides LAMG, CMG, and the Penn state people

4 Methodology

Fan Chung's local and global portion
multigrid on local portion and why it is optimal (cite gary miller multigrid on planar thing) (multigrid on meshes1984 achi brandt) (cite Ulrich Rude erlang and nuremberg 2015 sisc paper)
direct solve on sparse portion. low rank because its small
therefore use sherman morrison woodberry linear algebra to combine
somewhere in here need to explain networkx and petsc i think?
if we write in C talk about how it is first implementation

5 Results

Complexity analysis of all the individual parts

how fast is splitting for n edges?

multigrid $O(n)$

direct sparse solve is ?

how many mat-mat, mat-vec multiplies in the sherman morrison

table of times for different size graphs

maybe try to get it on a cluster to parallelize, or maybe do this after initial

thesis defense

maybe try to compare with LAMG in matlab

6 Applications

merge this into results graph laplacian linear systems of different types

C. elegans neural network

proteins and genes

facebook social networks

others? electric grids?

7 conclusions

how did we compare to LAMG and CMG our algorithm is arguably much simpler and cleaner. no heuristics talk about what worked and didnt

what will be improved upon

8 Bibliography from bibtex file