1. Introduction

- **Problems as Factor Graphs**
  - Many problems can be naturally cast as inference in factor graphs. We focus on estimating the partition function $Z = \sum_x w(x)$, e.g., number of solutions of a problem.
- **Loopy Belief Propagation as a Heuristic**
  - BP is exact on tree factor graphs, and often provides a surprisingly good approximation on other topologies.
- **Loop Series as Correction to BP**
  - Loop Calculus is a way to express the exact value of $Z$ as an (exponentially long) sum with BP’s estimate as a leading term.

2. Main Idea

Incremental improvement to BP’s estimate with a tunable efficiency/accuracy tradeoff.

3. Research Agenda

A) incremental improvement of BP’s estimate for number of solutions of a SAT problem
B) efficient partial summation of the loop series
C) empirical tests for applicability of the approach in the SAT domain

4. Discussion and Remarks

- Loop Calculus provides a way to incrementally improve on BP’s results.
  - It has been shown to improve quality of BP-based decoding in information theory, and in a particle tracking problem for learning flows.
- This research focuses on its application to SAT:
  - The problem is more general, the search space is more complicated.
  - Progress made towards loop series summation, but results do not yet show consistent improvement.
- Main future research goal is to identify problem domains with few important loops.
  - Where significant improvement is possible.