Outline for Master thesis: "Studies on approximations of Spanning Trees with Low Crossing Number"

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1. Introduction
   a) Definiton of the problem
      - Example graph in the plane
      - Crossing distance
      - Equivalence relation on line set
      - Worst case crossing number
   b) Generalization to d dimensions
   c) Variations of crossing numbers
      - Spanning crossing number (minimum crossing number)
      - Stabbing number
   d) Similiar problems
      - Perfect matching
      - Triangulations of minimum total lenght (*non* Steiner ones)
2. Complexity of the problem
   - Overview of NP-Hardness
   - Finding optimum
   - Integer Program with exponential constraints
3. Approximation approaches
   a) LP relaxation by Fekete
      - Planarity heuristics
      - Iterative rounding scheme

b) Multiplicative weights update scheme
   - Approximation algorithm
   - Used facts: crossing distance, crossing disk

c) General iterative, LP-based approximation scheme by Sariel
   - LP formulation with bounded VC dimensions
   - Listing of generic approximation algorithm
   - Randomized rounding scheme
   - Tailoring to d dimensions and planar case
   - Deterministic rounding in the plane

d) Challenges
   - Self crossing edges in approximation
   - Computing spanning tree within connected components
   - ...

4. New iterative, LP-based Approximation scheme
   - Sariel's approach revisited
   - LP formulation with connected components
   - Rounding scheme
   - Listing of the algorithm

5. Results
   a) Computational studies
      - Problem sets (Grid, Uniform distribution, high dimensional data sets, ...)
      - Implementation details
      - Hardware

   b) Observations on experiments
      - Pros and Cons of different approximation schemes
      - Comparison with Fekete's technical report

   c) Proofed facts

6. Related Work
   - Relative crossing number
   - Overall small crossing number

7. Conclusion