**Introduction**
We consider energy minimization for graphical models. We obtain a part of globally optimal solutions (persistent assignment).

**Properties**
- **Termination**: In general, it converges to a local optimum.
- **Runtime**: Exponential time in the worst case.
- **Ordering of variables**: Minimizes the number of variables to check.
- **Ordering of values**: Maximizes the number of variables to check.

**Optimization**
- **Minimum cut**: A cut is minimal if none of its edges can be removed while maintaining the same cut size.
- **Maximum cut**: A cut is maximal if adding any additional edge increases the cut size.

**Relaxed-improving conditions**
- **Strong and weak relaxation**: A relaxation method is strong if it always improves the objective function value.
- **Local relaxation**: A relaxation method is local if it only considers the interaction of a small subset of variables at a time.

**Message Passing**
- **Graph cut - based**: We consider the energy minimization problem:
  \[
  \min_{\phi} \sum_{\{u,v\} \in E} J(u,v) \phi(u) \phi(v)
  \]
  Subject to: \[\phi(v) \in \{0, 1\} \forall v \in V\]

**Algorithm**
- **Proposition**: If the relaxation is tight, then the objective function value is also tight.

**Examples**
- **LBP - Relaxation**
  \[
  \min_{\phi} \sum_{\{u,v\} \in E} J(u,v) \phi(u) \phi(v)
  \]
  Subject to: \[\phi(v) \in \{0, 1\} \forall v \in V\]

**Conclusion**
- **In-Painting**: N8
- **Color-Segmentation**: N8
- **Scene Decomposition**: Gould et al.

**Acknowledgments**
- **Kovtun (2003)**: Partial optimal labeling search for a NP-hard subclass
- **Goldstein (1994)**: Efficient rotamer elimination applied to protein
- **Szeliski et al. (2008)**: A comparative study of energy minimization algorithms for Markov random fields

**References**
- **Kohli et al. (2009)**: MQPBO
- **Alahari et al. (2010)**: Fast message passing for tree-structured Markov random fields

**Appendix**
- **Supplementary Material**: Additional theoretical results and experimental details.