Center for Eukaryotic Structural Genomics

Technology Dissemination Report

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Title	ACMI-Automatic Crystallography Map Interpretation
Research Unit	Crystallography
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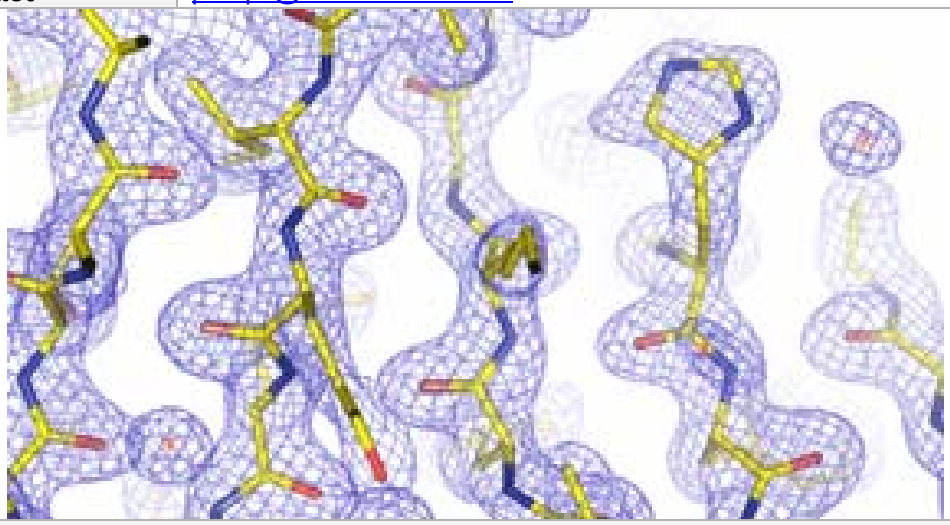

Summary

One particularly time-consuming step in protein crystallography is interpreting the electron density map; that is, fitting a complete molecular model of the protein into a 3D image of the protein produced by the crystallographic process. In poor-quality electron density maps, the interpretation may require a significant amount of a crystallographer's time. We have investigated automating the time-consuming initial backbone trace in poor-quality density maps [1−3]. We describe ACMI (Automatic Crystallographic Map Interpreter), which uses a probabilistic model known as a Markov field to represent the protein. Residues of the protein are modeled as nodes in a graph, while edges model pairwise structural interactions. Modeling the protein in this manner allows the model to be flexible, considering an almost infinite number of possible conformations, while rejecting any that are physically impossible. Using an efficient algorithm for approximate inference — belief propagation — allows the most probable trace of the protein's backbone through the density map to be determined. We have tested ACMI on a set of density maps (at 2.5 to 4.0 Å resolution) and have shown that ACMI offers a more accurate backbone trace than current approaches.

Publication(s):

[1] DiMaio, F., Shavlik, J., and Phillips, G.N., Jr. (2003) Using pictorial structures to identify proteins I X-ray crystallography density maps. Working Notes of the ICML Workshop on Machine Learning, in *Bioinformatics*.

[2] DiMaio, F., Shavlik, J., Phillips, G.N., Jr. (2006) A probabilistic approach to backbone tracing in electron density maps. *Bioinformatics* 22(14):e81-9.

[3] DiMaio, F., Soni, A., Phillips, G.N., Jr. and Shavlik, J. (2007) Improved methods for template-matching in electron density maps using spherical harmonics. *IEEE-BIBM 2007 Conference Proceedings*: 258-265.

Acquiring the Technology	ftp://ftp.cs.wisc.edu/machine-learning/shavlik-group/programs/acmi/
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