Three-dimensional Equilibrium Reconstruction and the V3FIT code

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The V3FIT[1] 3D (i.e. non-axisymmetric) equilibrium reconstruction code is based on the VMEC[2] 3D equilibrium solver. V3FIT has been successfully used for 3D reconstruction on stellarators, reversed field pinches, and tokamaks[3].

The equilibrium reconstruction proceeds by a least-squares minimization of a chi-squared function

$$\chi^2 = \sum_i \frac{\left( S_i^{\text{model}}(p_j) - S_i^{\text{observe}} \right)^2}{\sigma_i^2}$$

where the observed signals $S_i^{\text{observe}}$ come from the experiment, and the model-computed signals $S_i^{\text{model}}$ depend on the reconstruction parameters $p_j$ of the equilibrium model, and $\sigma_i^2$ is the variance in the $i$th observed signal. The reconstruction process can be interpreted in terms of probability distributions in the signal space and the reconstruction-parameter space.

Recently the V3FIT code has been enhanced with new capabilities: support for multi-color soft X-ray diagnostics, the ability to specify prior knowledge of reconstruction-parameter values; the ability to specify inequality constraints on reconstruction parameters; computation of posterior variances and correlations of model-computed auxiliary quantities, and computation of posterior correlations amongst reconstruction parameters. We will show examples of the new code capabilities, along with illustrations of the various probability distributions associated with the equilibrium reconstruction.

References:

