EIT逆问题

正则化项的选取十分关键，可以把一些先验知识通过加入到最优化的过程中。一般可以表达为的形式。 的选取有很多种方法，例如NOSER, Tikhonov, Laplace, exponential covariance, Gaussian HPF and time smooth prior等。zeroth-order Tikhonov regularization方法为单位阵。NOSRE方法中为对角阵[[1](#_ENREF_1)]，定义如下式所示：

能够采用不同的组合。如果为Tikhonov regularization，可以直接采用One step Gauss-Newton方法求解：

GREIT也是一种基于L2-L2的方法[[2](#_ENREF_2)]，它首先建立了规范化的成人和婴儿的胸部FEM模型，定义了衡量图像质量的若干准则，提出了一种基于大量仿真数据扰动的方法来获得重构矩阵的框架。L2-L2的方法为一种线性方法，有限元模型确定以后是固定的，因此直接通过获得图像，计算速度很快，目前的实时成像系统一般采用这种方法。

Wang的研究中，。这是一种的方法，由于不可导，需要采用迭代方法来求解。Wang采用了Split Bregman iterative algorithm（SB）算法[[3](#_ENREF_3)]，并与A fast iterative shrinkage-thresholding algorithm (FISTA))[[4](#_ENREF_4)]和interior-point方法 [[5](#_ENREF_5)]进行了对比。论文采用492有限元的模型，SB算法进行一次求解的运算时间为0.2364s（单个正则化参数），比FIST和IP方法更为快速。论文同时与TV和方法进行了对比，结果L2-L1的方法具有更高的精度。

Mamatjan 提出了primal-dual interior point method (PDIPM) algorithm对来解决L1范式求解问题，该方法可以求解各种范式组合[[6](#_ENREF_6)] 。The computation time (CPU time) for an increasing number of iterations was calculated, where it took 1.4 s for, 2.3 s for. took the least computation time (0.9 s), while took the most computation time (5.7 s) based on the stable solution that they produced. The results showed that an solution is not only more robust to unavoidable measurement errors in a clinical setting, but. it also provides high contrast resolution on organ boundaries.

Borsic 提出了一种Total variation (TV)正则化的方法[[7](#_ENREF_7)]，TV定义如下公式所示，其中代表边的编号，标号为和有限元(elements)的共同边为，边的长度为。，，为矩阵化后的结果。TV公式的物理意义可以这么理解：如果两个有限元相邻，而且公共边的长度很长，那么我们希望这两个有限元的差值较小。

TV方法转化为如下的最优化问题，，可以看出TV 方法的正则项为L1-norm。Javaherian提出了TVAL3方法来加速L2-TV性能[[8](#_ENREF_8)]，该方法基于ADMM方法。

Integrated EIT

tidal volume，end-expiratory lung volume change ( △EELV), compliance, ventilation delay, and over distension/collapse images were performed。Clinically useful parameters were successfully extracted including anterior/posterior ventilation ratio (A/P ratio), center of ventilation ( CoVx , CoVy ), global inhomogeneity (GI), coefficient of variation (CV), ventilation delay and percentile of overdistension/collapse[[9](#_ENREF_9)].

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