Fitting the kinetic modeling, we have three ways: ordinary least squared methods (OLS), MCMC methods, and variational inference (VI).

Depending on applications, different Ordinary least square methods are used. For instance, when dealing with the 18F-FDG, Patlak model is often selected hence linear least square fitting is used. When dealing with 11C-Recropride, SRTM model is often used which can either solved with non-linear least square fitting or with multi-linear least square fitting (MRTM). For details usage of each model, please refer to following pages.

An assumption of linear model will enable producing both mean and variance of each estimate parametric parameter. However, when using a non-linear model, this I not possible (or one want to have the full distribution rather than assumption of Gaussian). A way to generate multiple samples is using Bootstraping (see bootstrap.pptx).

Otherwise, we have to look at other approaches. A general one to deal with the sampling for a Bayesian problem is Markov Chain Monte Carlo (see mcmc.pptx). A fast approximation alternate is Variational Inference, which further assumes that posterior distribution is Gaussian (so are prior if conjugate one is used).

When prior is present, OLS (MLE) becomes MAP.

|  |  |  |
| --- | --- | --- |
|  | Pros | Cons |
| OLS (MAP) | Very fast | MLE estimate |
| OLS+bootstrap | Give variance | Very slow, assume Gaussian |
| MCMC | Give full distribution | Slow, difficult to update with new input, may not converge |
| VI | Fast, easy to derive update equation when a conjugate prior is chosen (equivalent to EM) | Assume gaussian, biased |

**CONTENTS**

**Fit\_pros/**

**../src**

**../external**

tcm2\_idl.c two tissue compartment fitting (k4=0) -

tcm2\_reverse\_idl.c two tissue compartment fitting -

patlak\_idl.c patlak linear model fitting (k4=0) +-

logan\_idl.cc logan linear model fitting +-

mrtm\_idl.cc multi-linear reference tissue model (same as srtm except t\*) +

mrtm2\_idl.cc(?)

srtm\_idl.cc simplified reference tissue model (k1/k2 constant, can model as

one-tissue compartment) +

frtm\_idl.cc(?) full reference tissue compartment (k2/k2 constant) +

rrtm\_idl.cc(?) full reference tissue model (k4=0) +

MA1\_idl.cc(?) multi-linear analysis -

MA2\_idl.cc(?) multi-linear analysis -

tcm3\_idl.cc(?) three tissue compartment model

tcm2\_dualinput\_idl.cc(?) two tissue compartment model with dual input function

mbf\_idl.cc(?) myocardial blood flow estimation (one compartment)

exp\_idl.cc(?) basic exponential model

tgo.c optimization, using powell or baboya

bootstrap.c, bootstrapr.c bootstrap sampling (with return samples)

Note: all programs are voxel-based. Image-based can be implemented with an interface program.

/home/tsun/bin/tpcclib-master/src/v1/libtpcmodel

/home/tsun/bin/tpcclib-master/src/v1/mtga (compile here)

**Sim\_pros/**

**../src**

Sim1cm.c simulate one-tissue comaprtment

Sim2cm.c simulate two-tissue comaprtment

simLogan.c simulate Logan

simPatlak.c simulate Patlak

simrtcm.c simulate srtm, frtm, rrtm

Makefile, configure

sim2cm\_idl.c external APIs below

simPatlak\_idl.c

simLogan\_idl.cc

simsrtm\_idl.cc

simrtcm\_idl.cc

rrtm\_idl.cc(?)

MA1\_idl.cc(?)

tcm3\_idl.cc(?)

tcm2\_dualinput\_idl.cc(?)

mbf\_idl.cc(?)

exp\_idl.cc(?)

Note: others are on meson

/home/tsun/bin/tpcclib-master/src/v1/libtpcmodel

/home/tsun/bin/tpcclib-master/src/v1/mtga (compile here)

**MCMC\_pros/**

**../src**

rwmh\_tac\_1tpc.c MCMC for one-tissue compartment model

rwmh\_tac\_2tpc.c MCMC for two-tissue compartment model

Note: others are on meson /home/tsun/bin/mcmc-master/tests/example

**VI\_pros/**

**../src**

Fwdmodel.c forward model registration

fwdmodel\_pet\_c1.c

fwdmodel\_pet\_c2.c

fwdmodel\_pet\_c2.h

inference\_nlls.c NLLS inference

inference\_vb.c VB inference

priors.c, priors.h non-spatial and spatial priors

Note: others are on meson /home/tsun/bin/fsl/install/src/fabber\_core

/home/tsun/bin/fsl/install/src/fabber\_core/fabber\_pet\_c2