Parameter Forecasts from CosmoMC

L. Perotto[*,1], J. Lesgourgues[+,2],

* *Laboratoire de Physique Subatomique et de Cosmologie (LPSC)*
   CNRS : UMR5821, IN2P3, Université Joseph Fourier - Grenoble I, Institut Polytechnique de Grenoble,
France

Here we review the changes to be applied in the public code CosmoMC[3] (written by A. Lewis) in order to perform error forecasting on cosmological parameters for future CMB experiments. It consists of two steps:

1   Mock data generation

First, ones creates a mock data set for the experiment under consideration. Such a data set will be organised in a form readable by the `cmbdata` module of CosmoMC:

multipole	CMB observables					Noise spectra			sky fraction
l	$\hat{C}_l^{TT}$	$\hat{C}_l^{TE}$	$\hat{C}_l^{EE}$	$\hat{C}_l^{dd}$	$\hat{C}_l^{Td}$	N_l^T	N_l^P	N_l^d	f_{sky}

The code FUTURCMB we provide achieves this purpose. Note that this approach can be simplified in several ways:

- First, the error forecast can be performed either from the estimate of the fiducial spectra given a particular realization of the spherical harmonic expansion coefficients, or from the fiducial spectra themselves. In the later case, there is no need to generate mock data, but our code can still be useful for computing the noise N_l^d associated with the lensing extraction technique.

- Second, you can decide to use only the temperature data instead of temperature + polarization observables. In the same way, including the lensing observables ($\hat{C}_l^{Td}$ and $\hat{C}_l^{dd}$) is optional.

2   Likelihood calculation

In the `cmbdata` module, ones modifies the χ^2 calculation to take into account the lensing observables if they are asked for. It just asks to replace the actual `ReadAllExact` and `ChiSqExact` functions of the `cmbdata` module by the new ones we provide.

Finally, including lensing observables will lead to few changes in two CosmoMC files.

---

[1]E-mail: perotto@lpsc.in2p3.fr
[2]lesgourgues@lapp.in2p3.fr
[3]http://cosmologist.info/cosmomc/

- First, the number of used power spectra will be 5 instead of 3 (The temperature and polarization spectra plus $\hat{C}_l^{Td}$ and $\hat{C}_l^{dd}$). This has to be written in `cmbtypes` file of CosmoMC such as:

```
integer, parameter :: num_cls = 5
integer :: num_clsS=min(num_cls,5)
```

in replacement of existing, similar lines.

- Second, two lines should be changed in the `CMB_Cls_simple` module. The power spectra array including lensing observables should be described, such as:

```
integer, parameter :: ScalClOrder(5) = (/1, 3, 2, 4, 5/)
integer, parameter :: TensClOrder(4) = (/1, 4, 2, 3/)
```

If lensing extraction is chosen (i. e. the number of spectra is 5), the `Do_Lensing` option has to be selected when CAMB[4] is called, although the `CMB_Lensing` option in the CosmoMC parameter file is defined as false. In the `CMB_Cls_simple` module, it leads to the following changes:

```
!if (CMB_Lensing) then
if (num_cls == 5) then
    P%DoLensing = .true.      (no change)
    P%Max_l = lmax +250       (no change)
    P%Max_eta_k = P%Max_l*2   (no change)
end if                        (no change)
```

---

[4] http://camb.info/