CODE: `Cflat`

I. WHAT DOES IT DO?

It computes the flat-sky power and bispectra for any shape (also non-factorizable). It currently is restricted to TTT, BTT and BEE. More will follow. It can compute TT (scalars), EE (scalars and tensors) and BB (tensors). For the code to run you need to have the correct source functions from `CLASS` (`CAMB` only works for temperature). `CLASS` source functions can be printed directly from `transfer.c`. A modified version of this file can be found in the directory. The accuracy of the code is 5% for E and B and about 1% for T down to $\ell = 20$.

II. FILES

The code has 7 files including a makefile.

- `settings.f90`: contains settings from file names to cosmological parameters.
- `FlatSkyTransfer.f90`: computes real and imaginary components of the transfer functions (see below).
- `CMBFlat.f90`: computes the power and bispectra and prints them to a file
- `interpolation.f90`: contains various interpolation routines used in the code
- `modules.f90`: contains routines to compute the signal to noise. both in 2D as well as 3D (using 2D to 3D bispectrum association as in Hu 2002).
- `driver.F90`: driver for running all routines separately (or in order).
- `Makefile`: makefile to make executable. Tested with various versions of gcc and ifort. Works on most (no special functions used or libs). Uses openMP (highly recommended).

III. TRANSFER FUNCTIONS

The module `FlatSkyTransfer.f90` computes the transfer functions from the source functions. It first interpolates the source functions. Then it performs an integral over comoving distance τ. For T, E and B it computes the following:

$$\mathrm{T}^{\mathrm{x,X}}_{\mathrm{cos},\ell} = \int d\tau D^{-2}\cos(k(\tau-\tau_R))S^{x,X}(\sqrt{k^2+(\ell/D)^2},\tau) \tag{1}$$

$$\mathrm{T}^{\mathrm{x,X}}_{\mathrm{sin},\ell} = \int d\tau D^{-2}\sin(k(\tau-\tau_R))S^{x,X}(\sqrt{k^2+(\ell/D)^2},\tau) \tag{2}$$

$$\tag{3}$$

with $x = \{s, h\}$ and $X = \{T, E, B\}$ and $D = \tau - \tau_0$ while τ_R is the comoving distance at the LSS (e.g. $\tau_R \sim 280$ Mpc in our Universe).

IV. POWER AND BISPECTRA

Using the output above (which will be stored, so for a fixed cosmology these only have to be computed once), the power spectra are computed using the flat-sky integrals. E.g. the temperature power spectrum from scalars is then computed as

$$C^{s,T}_\ell = (2\pi)A_s(\tau_R-\tau_0)^2\int dk((\mathrm{T}^{s,T}_{\mathrm{cos},\ell})^2+(\mathrm{T}^{s,T}_{\mathrm{sin},\ell})^2)/q^3 \tag{4}$$

with $q = \sqrt{k^2+(\ell/(\tau_R-\tau_0))^2}$.

The polarization source function for tensors differs a factor of 4 from the usual definition, which is taken into account. In the scalar polarization source function there is a factor of (3./8.) which is included in the computations of the flat-sky transfer functions.