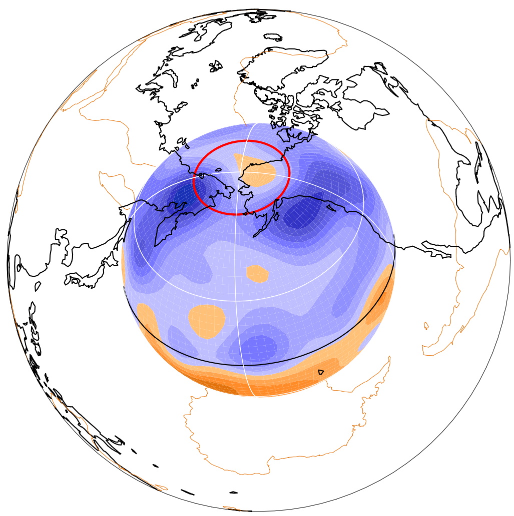
LEOPACK



svpnsmap

Solution **V**ector **P**erturbation **N**ew **S**patial **M**esh
Adaption **P**rogram

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1 svpnsmap

Solution **V**ector **P**erturbation **N**ew **S**patial **M**esh **A**daption **P**rogram

Takes in a standard solution vector (i.e. `.ints`, `.vecs` and `.xarr` files) and interpolates the solution onto a new grid specified by an input file. The new solution vector is output in standard form. If a radial function in the new solution vector is present in the old solution vector, then the old radial function is interpolated onto the new radial spacings grid. If a radial function in the new solution vector is not present in the old solution vector, then a "random" function is added, scaled by a number `DMAG`. Setting this number to zero will ofcourse just add zero radial functions to the new solution vector.

Whether or not to add numerical noise to the new radial functions largely depends upon the type of calculation you wish to perform with the new solution vector. It is best to avoid adding artificial noise to the solution vector if possible. For example, if you merely wish to include spherical harmonics with higher degree, l, then the Coriolis force will couple them directly and no additional noise is required. If a solution includes wavenumbers 0,2,4 and 6, then using `svpnsmap` to add the wavenumber $m = 8$ to the solution vector would not require addition noise: the non-linear terms will couple them to existing non-zero functions. However, if you wish to add the wavenumbers 1,3,5 and 7, then noise would have to be added to the new radial functions.

The inputs file must have the following format.

```
* input file for svpnsmap
*
example_a.ints                      : Harmonics file
example_a.vecs                      : Vector file
example_a.xarr                      : Radial grid node spacings
example_aOUTPUT                     : Filename stem
 50    2     4     6     0.0        : NRNEW  ISP   IFORMF NNDS DMAG
 36    1    -1   2   1    24        : LHV ISV LHM ISM MINC MMAX
```

Any line in the input file beginning with an asterisk, `*`, is ignored by the program and can thus be used to enter comments and notes.

The arguments are as follows

- `Harmonics file`: name of already existing indices file describing a solution vector.
- `Vector file`: name of already existing vector file describing solution. Must contain the same number of radial functions as indicated in the `.ints` file.

- `Radial grid node spacings`: name of already existing radial spacings file describing solution. Must contain the same number of radial grid nodes as indicated in the `.vecs` file.
- `filename stem`: First characters in output files to be generated by current run. Running `svpnsmap` with the above input file will create the files `example_aOUTPUT.ints`, `example_aOUTPUT.vecs` and `example_aOUTPUT.xarr`.
- `NRNEW` The number of radial grid nodes the new solution is to have.
- `ISP`: Flag for the spacing of the new radial grid nodes. Can take the options
  1. Forces evenly spaced grid nodes from `ESNAAS`.
  2. Forces Chebyshev-zero spaced nodes from `ZCPAAS`
- `IFORMF`. Flag which chooses the order in which elements in the solution vector are stored. `IFORMF` can take the values `3` or `4`
- `NNDS`: Number of grid nodes used for interpolation of radial functions by `SVRINT`.
- `DMAG`: Scales the noise added to new radial functions.
- `LHV`. Highest spherical harmonic degree, l, requested for velocity. This is the numbers $L1$, $L2$ and $L3$
- `ISV`. Requested symmetry for the velocity.
  1. Velocity is equatorially symmetric.
  2. Velocity is equatorially anti-symmetric.
  3. Velocity contains both equatorially symmetric and equatorially anti-symmetric parts.
- `LHM`. Highest spherical harmonic degree, l, requested for magnetic field. This is the numbers $L4$ and $L5$.
- `ISM`. Requested symmetry for the magnetic field.
  1. Magnetic field is equatorially symmetric.
  2. Magnetic field is equatorially anti-symmetric.
  3. Magnetic field contains both equatorially symmetric and equatorially anti-symmetric parts.

- `MINC`: The lowest non-zero wavenumber to be included. Note $m = 0$ is always included.
- `MMAX`: Maximum wavenumber.

1.1 Subprograms required for svpnsmap

SUBS subroutines

```
hmfrd.f svfrd.f xarrrd.f hminda.f esnaas.f zcpaas.f
svrint.f hmfwt.f xarrwt.f svfwt.f fopen.f fclose.f
gfdcfd.f fnamer.f matop.f
```

SUBS integer function

```
indfun.f
```

BLAS integer function

```
idamax.f
```

BLAS subroutines

```
dgemv.f dgemm.f dtrsm.f dswap.f dger.f  dscal.f
dtrmm.f dtrmv.f
```

LAPACK subroutines

```
xerbla.f dgetrf.f dgetri.f dgetf2.f dlaswp.f dtrtri.f
dtrti2.f
```

LAPACK integer function

```
ilaenv.f
```

LAPACK logical function

```
lsame.f
```

1.2 Run-time limitations

Several parameters are set at the outset which limit the physical size of the problem.

```
 INTEGER NRMAX, NHMAX, ISVMAX, LHMAX, NDCS, NNDM
 PARAMETER ( NRMAX = 300, NHMAX = 6000, LHMAX = 100,
1            NDCS = LHMAX+4, ISVMAX = NRMAX*NHMAX, NNDM = 6 )
```

If the values are insufficient, then change them and recompile.

- `NRMAX` is the maximum number of radial grid nodes allowed.
- `NHMAX` is the maximum number of spherical harmonic radial functions allowed.
- `LHMAX` is the highest permitted spherical harmonic degree, l.
- `NNDM` is the maximum permitted value of `NNDS`.

1.3 Outputs from SVPNSMAP

If the filename stem "root" was specified in the input file, the files `root.ints`, `root.vecs` and `root.xarr` will all be created.

1.4 Sample runs of svpnsmap

The directory

```
$LEOPACK_DIR/SAMPLERUNS/SVPNSMAP
```

contains example input files and model output. Do not under any circumstances edit these files, as these examples should serve as a control for the correct working of the code. After compiling the program, copy the `.input` files to another directory, run the code and confirm that the output agrees with that in the directory.

1.4.1 Example a

The solution described by the files

```
example_a.ints    example_a.vecs    example_a.xarr
```

is non-magnetic, has maximum l of 32, includes all wavenumbers, m, up to 24 and is restricted to equatorially symmetric components. It is represented at 40 radial grid nodes. The file `example_a.input` interpolates the function onto a grid with maximum degree 52 and 50 radial grid nodes with Chebyshev-zero spacing. Since, other than the radial regridding, we are merely adding more modes in l, we set `DMAG` to zero: noise will not help us here.

References