Scalabilization of Fullpos/927

A Report on the scalability issues of F*ull*pos/927 in the Arpege / Aladin

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1. INTRODUCTION

F*ull*Pos is a Post-Processing package embedded inside the Arpege/IFS/Aladin software. It is fully compatible with the model itself. Mainly, it is composed of two pieces, vertical interpolations and horizontal interpolations.

F*ull*Pos needs the auxiliary library for the I/Os and for the spectral transforms it uses TFL and TAL externals. It can be run with respect to the proper namelist of Arpege/IFS/Aladin cycle using in the experiment. While some of the namelist variables are only private to the F*ull*Pos, model variables in the namelist are also used.

When making historical files in F*ull*Pos, it needs to invoke two parts which are required to start the control cascade from almost the beginning. By removing the code below the condition LFPART2 and making more straightforward mechanism instead is planed in this study. Scalability of F*ull*POS can be increased avoiding from these limitations.

This study has started September 2010, during this period; spectral package debugged if it has ability to setup two different type of geometry. Some of the routines in the package are modified to have a convenient way of keeping different type of geometries. Grid point transposition from FPOS distribution to the spectral distribution is computed.

2. AN OVERVIEW

In the new (e)(e)927 the STEPO sequence;

```
0AA0M0000
0000I0000
0000E0FF0
Z00000000
```

NFPSPEC is the integer number that activate the kind of new algorithm used in F*ull*POS. It is located in the NAMCT0 namelist block. If it is 0, then it may be called as ordinary post-processing which means it just performs the interpolations without changing the spectral geometry. In the case of 1, it indicates that it is one of the configuration 927 family (927 arp2arp ,e927 arp2ald ,ee927 ald2ald). If it is equal to 2 then it is a new algorithm plugged into the source code.

NFPSPEC = 0 => ordinary F*ull*POS (LFPSPEC=.F.)
NFPSPEC = 1 => 927, e927, ee927 (LFPSPEC=.T.)
NFPSPEC = 2 => new mechanism (LFPSPEC=.F.)

LFPSPEC .T. = Post-processed dynamic fields are written out as spectral

coefficients

.F. = Post-processed dynamic fields are written out as grid point values.

Each call to setup routines (SETUP_TRANS and SETUP_ETRANS) creates a new resolution up to a maximum of NMAX_RESOL setup in SETUP_TRANS0 and updates the values for LTYPE_TRANS.

SUTRANS or SUETRANS is called in the second part of the setup which is SU0YOMB. Consequently, first resolution has been defined. For the setup of the second resolution SUFPTRANS is considered as a new routine which is called by SUBFPOS. After completing setup of the second geometry, global address of each grid point on each processor saved in an array both for the C+I and E zone (in the case of LELAM). Some of the informations are inquired from the transform package.

Number of grid points will be send to the other processor and their addresses together with the receiver part is used as a input to a new routine called as TRFP2TRANS. It is mainly extract the fields both for C+I and E zone.

3. VALIDATION

TRFP2TRANS is called by STEPO that checks the already changed CDCONF (configuration of STEPO) by DYNFPOS. CDCONF(7:8)='FF' is the new configuration which is controlled by NFPSPEC=2 in the routine DYNFPOS. New configuration is activated in the horizontal and lagged vertical post-processing part of the DYNFPOS.

New mechanism can only be activated If there are fields to be spectrally fitted in DYNFPOS. That's why we have to define under circumstances a given field on a given level should be spectrally fitted. Decision is made in the subroutine SUVPOS. DYNFPOS is modified to check the number of fitted fields(NFPGT1), if it is bigger then zero, then the new mechanism can be activated. Also, in the specific case of the new 927, restrictions in the SUVFPOS which are using to decides for QFPTYPE variables are removed both for surface fields and upper fields.

Exaction of E-zone and send or received according to target distribution already setup in SUFPTRANS is coded. Same method was mainly used for C+I zone.

Extracted fields needs to be sliced of NFPROMA to able to call the direct spectral transform (from grid-point to spectral). However, routines which are performs the direct spectral transform of F*ull*Pos (TRANSDIR_FP and ETRANSDIR_FP) are using global variables for dimensioning of arrays. These global variables need to be replaced by inquired variables. Therefore, KRESOL added these two routine as a dummy argument. Thus, the local arrays converted to allocatable arrays which are dimensioned by inquired with the proper KRESOL from the transform package.

Spectral array which is already transformed is going to use to call the FPSPNORM which is a routine that computing spectral norms. Spectral norms are required to make a comparison between the new mechanism(NFPSPEC=2) and the old mechanism(NFPSPEC=0,1).

That's why, mechanism in the FPSPNORM is modified. KRESOL added to have a more modular routine. According the resolution number given FPSPNOM can handle the spectral norms. Furthermore, the mechanism in the FPSPNORM is re-arranged to use SPECNORM and

ESPECNORM. FPSPNORM is tested if it can still compute the same results. Tested new FPSPNORM can be used for the grid point transposition from FPOS distribution to the spectral distribution.

3.1. TESTS

Before the final validation of the new mechanism three kind of tests are done. These are essential to be sure that we did not give any harm to existing flow, modified routines are still computing the same results and MPI distribution is effecting the results or not.

3.1.1. NEUTRALITY

While the NFPSPEC=2 is controlling the new algorithm, NFPSPEC=0,1 are representing the existing flow of the FPOS. This test is essential for the be sure that existing flow is not broken. NFPSPEC=0,1 in the new flow of FPOS are representing the LFPSPEC true or false in the existing flow. Therefore, in the case of NFPSPEC=0,1 and LFPSPEC true or false should compute the same norms. Also, this test is done several times with different MPI distributions.

3.1.2. TRANSPARENCY

By keeping only grid-point fields in the namelist, NFPSPEC=2 and NFPSPEC=0 are compared. Different MPI distributions are also tested.

3.1.3. IDENTITY

In this tests, departure geometry and target geometry are the same. Thus, spectral norms computed both for in the case of NFPSPEC=2 and NFPSPEC=0,1 and they are compared to each other. Different MPI distributions are also tested.

MPI distributions are tested for the different values of NPRTRW, NPRTRV(Numbers of processors used respectively for the waves distribution and the vertical distribution in spectral space) and NPRGPNS, NPRGPEW (Numbers of processors used respectively for the North-South and East-West grid point distributions).

3.2. FINAL VALIDATION

After all these tests, (e)(e)927 cases tested both for surface and upper air fields. Spectral norms which are computed are slightly different from each other for the surface fields. This problem especially appeared for the surface fields, while the upper fields at the top are identical. Same results at the top of the atmosphere shows that new mechanism is working. Due to the vertical interpolations effected from orography seems the reason for the problem close to the surface. Testing on the problem of the vertical interpolations are still on progress.

3.1 List of Modifications and New Routines

Name of the Routine	Modifications
TRANSDIR_FP	KRESOL added, global array dimensions replaced by inquired ones.
ETRANSDIR_FP	KRESOL added, global array dimensions replaced by inquired ones.
FPSPNORM	KRESOL added, SPECNORM and ESPECNORM
TRFP2TRANS	E-zone
DYNFPOS	Control of NFPGT1 in the case of NPFSPEC=2
SUVPOS	QFPTYPE variables are removed in the case of NPFSPEC=2

Table 3.1: *List of modified source codes*

4. CONCLUSION

F*ull*POS is a post-processing package containing many features such as making ARPEGE or ALADIN history files, whether starting from a file ARPEGE or a file ALADIN. However, these sequence subdivided into two parts (internal and external part) which are required I/O operations and starting control cascade from the beginning in order to change the setup of the spectral transform . Scalability of F*ull*POS can be increased avoiding from these limitations.

In this study, target distribution of the grid points which are already computed are transformed and grid point transposition from FPOS distribution to the spectral distribution was also computed and its validation has been done. Modular spectral norms wrapper for FPOS is coded and validated.

Three kind of test methods (neutrality, transparency, identity) applied before the validation of NFPSPEC=2. Then, spectral norms get slightly different from each other when we get closer to the lower levels. These differences captured near the surface and identical at the top shows that the problem is related to vertical interpolations.

Filter on the fields should be applied to make a selection if the fields are in grid-point or spectral before calling direct spectral transform. By the way, some of the fields will be kept in grid-point. Vector fields and orography spectral fit (if not provided by climatology) aspects should be considered as well.

I/O part will write out spectrally fitted fields and grid-point fields into a file as a next step.