MorphCol Supplement #25 - Resort program

Michael Knappertsbusch, 16. February 2018

```
      PROGRAM RESORT
C
C     Version 1.2, by Michael Knappertsbusch, 5 February 2018.
C     Modified from version 1.1, 11.2.2018
C
C     !!! Processing in batch mode. !!!
C
C     Given are the cartesian coordinates of a plane closed outline curve with 250 equiangular
C     points (as for example obtained as interpolaed points from program Sprep53 in form of the
C     _INT files). The numbering of the points starts with the first point on the left side, usually
C     on or near the apex of a foram in profile view. The direction of counting of coordinates is
C     anticlockwise.
C
C     For reasons of geometrically comparing different outlines it is sometimes desirable to have
C     geometrically congruent coordinates. To achieve this we reassign the starting point of
C     all outline points in the uppermost keel region instead at the apex.
C
C     Note, that by this transformation true homology is only maintained in the highest keel region point.
C     All other points will be "pseudo-homologous", i.e. geometrically homologous.
C     The program Resort1  re-organises the outline points in such a way, that the starting point falls on
C     the point with the maximum Y-coordinate, i.e. with the top of the upper keel region.
C     The direction of counting remains the same as before.
C
C     Also note, that version 1.0 is conditional for an outline where the upper keel region is convex
C     and with a single maximum point with index PMAX. The point X(PMAX),Y(PMAX) will serve as the new
C     starting point of the re-sorted outline.
C
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C     Resort version 1.1 (Resort11.out):
C     In the case that the uppermost keel region extends horizontally over several neighboring points,
C     i.e. with the same maximum Y-coordinate (YMAX), then the starting point of the re-sorted
C     outline needs to be shifted to the left depending on the number of horizontal points in the
C     uppermost keel region. This correction is implemented in program Resort version 1.1.
C
C
      INTEGER MAX,PMAX,NEXP,K
      PARAMETER (MAX=250)
      INTEGER DELTA1, DELTA2
      DIMENSION X(1:MAX), Y(1:MAX)
      DIMENSION XN(1:MAX), YN(1:MAX)
      REAL YMAX
      CHARACTER*20 FILE_LIST
      CHARACTER*19 INPUT, OUTPUT
C
C
C     Explanation of variables:
C     K          Number of outlines to be processed.
C     MAX        Total number of points in outline.
C                MAX=250 if _INT files are used from program Sprep53.
C     PMAX             Index number of the point with the highest Y-coordinate (maximum point).
C     YMAX             Maximum Y-coordinate of the outline.
C     DELTA1           Difference of indices of corresponding points between old outline and resorted
C                outline from point No. 1 until the point just before point PMAX ("upward direction").
C     DELTA2           Difference of indices of corresponding points between old outline and resorted
C                outline from point PMAX until the last point (MAX) of the outline ("upward direction").
C     NEXP       Total number of neighboring points in uppermost keel region with Y=YMAX.
C                If there is no horizontal section of upper most keel region, NEXP is equal to 1.
C     X          Vector (elements 1 to MAX) containing the X-coordinates of points of the original outline.
C     Y          Vector (elements 1 to MAX) containing the Y-coordinates of points of the original outline.
C     XN         Vector (elements 1 to MAX) containing the X-coordinates of points of the re-sorted outline.
C     YN         Vector (elements 1 to MAX) containing the Y-coordinates of points of the re-sorted outline.
C     FILE_LIST  Name of the file containing the names of input file names with outline coordinates.
C     INPUT            Name of the file containing the original outline coordinates.
C     OUTPUT           Name of the file containing the re-sorted outline coordinates.
C
```

```
C   Input: One file INPUT containing the x,y coordidates of the outline.
C   Output: One file containing the re-organised x,y coordinates of the outline.
C
C     Subroutines required: EXTREMA
C
C
C
C
      WRITE(9,*)   '************************************************'
      WRITE(9,*) '*                                              *'
      WRITE(9,*) '*          Program Resort                      *'
      WRITE(9,*) '*     Makes outline geometrically congruent    *'
      WRITE(9,*) '*                                              *'
      WRITE(9,*) '*    Version 1.2, by Michael Knappertsbusch    *'
      WRITE(9,*) '*                                              *'
      WRITE(9,*) '*        !!! Batch processing mode !!!         *'
      WRITE(9,*) '*                                              *'
      WRITE(9,*)   '************************************************'
      WRITE(9,*) ' '
      WRITE(9,*) '. . .For outlines with ',MAX,' points. . .'
      WRITE(9,*) '. . .Enter list with names of input files. . .'
      WRITE(9,*) '              (max. 20 chars)'
C
      READ(9,2) FILE_LIST
 2    FORMAT(A20)
      OPEN(17,FILE=FILE_LIST,STATUS='OLD')              ! File list stays open until end.
C
      K=0                                        ! Initialize counter K for input files
 3    K=K+1
      READ(17,5,END=999) INPUT
 5    FORMAT(A19)
      WRITE(9,*) '. . .Reading ',INPUT
C
      OPEN(18,FILE=INPUT,STATUS='OLD')
C
```

```
      DO 10, I=1,MAX
         READ(18,*)  X(I),Y(I)
 10   CONTINUE
C
C***  Determine  upper  keel  xtreme  (YMAX):
C
      CALL EXTREMA(Y,MAX,YMAX,PMAX)
C
C
C***  Modification  for  the  case  that  the  uppermost  keel  region  extends  over  several  horizontally  neighboring  points:
C     First  count  number  of  such  neighboring  points  along  horizontal  section  in  uppermost  keel  region.
C
      NEXP=1
      DO 15, I=PMAX,MAX-1
        IF (Y(I+1).EQ.YMAX) THEN
         NEXP=NEXP+1
        END IF
 15   CONTINUE
C
C
C     Now,  displace  the  new  starting  point  along  horizontal  section  in  the  middle  between  points  with
C     indeces  PMAX  and  PMAX+NEXP-1:
C
      PMAX=PMAX+INT((NEXP-1)/2)
C
      DELTA1=MAX-PMAX+1      !  New  DELTA1  for  upwards  re-sorting
      DELTA2=PMAX-1          !  New  DELTA2  for  downwards-resorting
C
C***  Performing  "upwards-resorting"  of  indeces  from  point  1  to  just  one  point  before  PMAX:
C
      DO  20, I=1,(PMAX-1)
        XN(I+DELTA1) = X(I)
        YN(I+DELTA1) = Y(I)
 20   CONTINUE
```

```
C
C***  Now performing "downwards-resorting" of indices from point PMAX to last point (MAX) of outline:
C
      DO 30, I=PMAX,MAX
        XN(I-DELTA2)=X(I)
        YN(I-DELTA2)=Y(I)
 30   CONTINUE
C
C***  Output of re-sorted outline to file OUTPUT:
C
      OUTPUT=INPUT(1:15)//'_RSD'
      OPEN(19,FILE=OUTPUT,STATUS='NEW')
C
      DO 40, I=1,MAX
        WRITE(19,*)  XN(I),YN(I)
 40   CONTINUE
C
C
      CLOSE(18)
      CLOSE(19)
C
      GOTO 3
C
 999  WRITE(9,*) '. . .',K-1,' files processed. . .'
      PAUSE 1000
 1000 CONTINUE
C
      STOP
      END
```

```
      SUBROUTINE EXTREMA(V,IMAX,VMAX,QMAX)
C
C     Subroutine to determine the largest element VMAX in vector V.
C     IMAX is the total number of elements in vector V.
C     QMAX is the index number of element VMAX.
C     V and IMAX enter the subroutine, VMAX and QMAX are returned to the calling unit.
C
C
      INTEGER IMAX,QMAX
      DIMENSION V(1:IMAX)
      REAL VMAX
C
      VMAX=0.0                    ! Initialize highest V-coordinate of outline
      QMAX=0                            ! Initialize counter
C
      DO 10, I=1,IMAX
        IF (V(I).GT.VMAX) THEN
          VMAX=V(I)
          QMAX=I                  ! Determine the index that belongs to VMAX
        END IF
 10   CONTINUE
C
      RETURN
      END
```

```
      PROGRAM RESORT
C
C     Version 1.0, by Michael Knappertsbusch, 5 February 2018.
C
C     Given are the cartesian coordinates of a plane closed outline curve with 250 equiangular
C     points (as for example obtained as interpolaed points from program Sprep53 in form of the
C     _INT files). The numbering of the points starts with the first point on the left side, usually
C     on or near the apex of a foram in profile view. The direction of counting of coordinates is
C     anticlockwise.
C
C     For reasons of geometrically comparing different outlines it is sometimes desirable to have
C     geometrically congruent coordinates. To achieve this we reassign the starting point of
C     all outline points in the uppermost keel region instead at the apex.
C
C     Note, that by this transformation true homology is only maintained in the highest keel region point.
C     All other points will be "pseudo-homologous", i.e. geometrically homologous.
C     The program Resort re-organises the outline points in such a way, that the starting point falls on
C     the point with the maximum Y-coordinate, i.e. with the top of the upper keel region.
C     The direction of counting remains the same as before.
C
C     Also note, that version 1.0 is conditional for an outline where the upper keel region is convex
C     and with a single maximum point with index PMAX. The point X(PMAX),Y(PMAX) will serve as the new
C     starting point of the re-sorted outline.
C     If the upper keel region extends horizontally over several neighboring points, i.e. with the
C     same maximum Y-coordinate (YMAX), then the starting point of the re-sorted outline needs to be
C     shifted to the left depending on the number of horizontal points in the uppermost keel region.
C     This correction is implemented in program Resort version 1.1.
C
C
C
C
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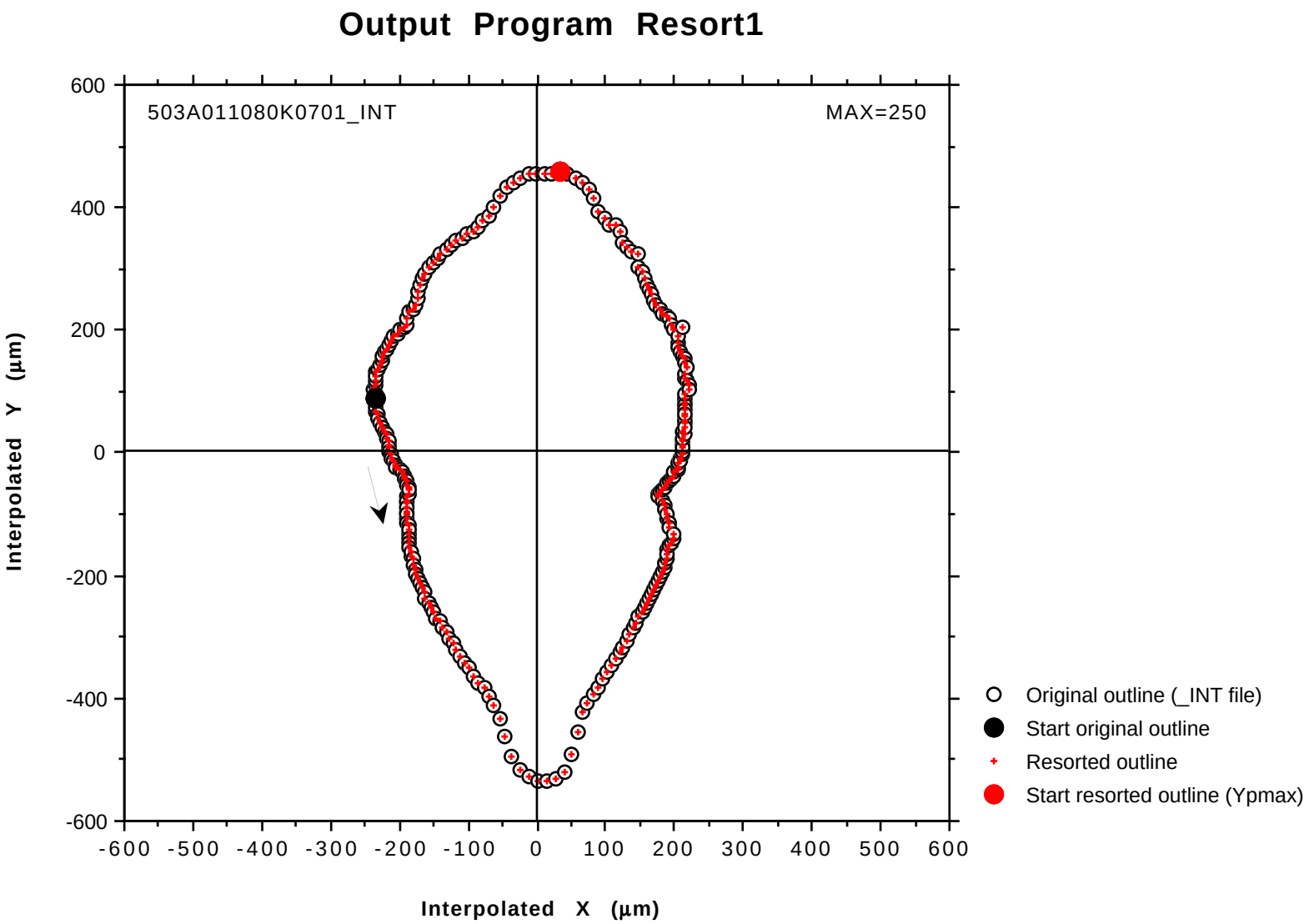
```
      INTEGER MAX,PMAX
      PARAMETER (MAX=250)
      INTEGER DELTA1, DELTA2
      DIMENSION X(1:MAX), Y(1:MAX)
      DIMENSION XN(1:MAX), YN(1:MAX)
      REAL YMAX
      CHARACTER*19 INPUT, OUTPUT
C
C
C     Explanation of variables:
C     MAX         Total number of points in outline.
C                 MAX=250 if _INT files are used from program Sprep53.
C     PMAX              Index number of the point with the highest Y-coordinate (maximum point).
C     YMAX              Maximum Y-coordinate of the outline.
C     DELTA1            Difference of indices of corresponding points between old outline and resorted
C                 outline from point No. 1 until the point just before point PMAX ("upward direction").
C     DELTA2            Difference of indices of corresponding points between old outline and resorted
C                 outline from point PMAX until the last point (MAX) of the outline ("upward direction").
C     X           Vector (elements 1 to MAX) containing the X-coordinates of points of the original outline.
C     Y           Vector (elements 1 to MAX) containing the Y-coordinates of points of the original outline.
C     XN          Vector (elements 1 to MAX) containing the X-coordinates of points of the re-sorted outline.
C     YN          Vector (elements 1 to MAX) containing the Y-coordinates of points of the re-sorted outline.
C     INPUT             Name of the file containing the original outline coordinates.
C     OUTPUT            Name of the file containing the re-sorted outline coordinates.
C
C
C   Input: One file INPUT containing the x,y coordidates of the outline.
C   Output: One file containing the re-organised x,y coordinates of the outline.
C
C     Subroutines required: EXTREMA
C
C
C
C
```

```
      WRITE(9,*)   '************************************************'
      WRITE(9,*) '*                                      *'
      WRITE(9,*) '*          Program Resort              *'
      WRITE(9,*) '*                                      *'
      WRITE(9,*) '*    Version 1.0, by Michael Knappertsbusch    *'
      WRITE(9,*) '*           (Single file processing)   *'
      WRITE(9,*) '*                                      *'
      WRITE(9,*) '*     Makes outline geometrically congruent    *'
      WRITE(9,*) '*                                      *'
      WRITE(9,*)   '************************************************'
      WRITE(9,*) ' '
      WRITE(9,*) '. . .Enter name of input file. . .'
      WRITE(9,*) '          (19 chars)'
C
      READ(9,5) INPUT
 5    FORMAT(A19)
C
      OPEN(18,FILE=INPUT,STATUS='OLD')
C
      DO 10, I=1,MAX
        READ(18,*) X(I), Y(I)
 10   CONTINUE
C
C
C***  Determine upper keel xtreme (YMAX):
C
      CALL EXTREMA(Y,MAX,YMAX,PMAX)
C
      DELTA1=MAX-PMAX+1
      DELTA2=PMAX-1
C
C***  Performing "upwards-resorting" of indeces from point 1 to just one point before PMAX:
C
      DO 20, I=1,(PMAX-1)
        XN(I+DELTA1) = X(I)
        YN(I+DELTA1) = Y(I)
 20   CONTINUE
```

```
C
C*** Now performing "downwards-resorting" of indices from point PMAX to last point (MAX) of outline:
C
      DO 30, I=PMAX,MAX
        XN(I-DELTA2)=X(I)
        YN(I-DELTA2)=Y(I)
 30   CONTINUE
C
C*** Output of re-sorted outline to the screen and file OUTPUT:
C
      OUTPUT=INPUT(1:15)//'_RSD'
      OPEN(19,FILE=OUTPUT,STATUS='NEW')
C
      DO 40, I=1,MAX
        WRITE(9,*)  XN(I),YN(I)          ! Output to screen
        WRITE(19,*)  XN(I),YN(I)
 40   CONTINUE
C
      CLOSE(18)
      CLOSE(19)
C
      STOP
      END
```

```
      SUBROUTINE EXTREMA(V,IMAX,VMAX,QMAX)
C
C     Subroutine to determine the largest element VMAX in vector V.
C     IMAX is the total number of elements in vector V.
C     QMAX is the index number of element VMAX.
C     V and IMAX enter the subroutine, VMAX and QMAX are returned to the calling unit.
C
C
      INTEGER IMAX,QMAX
      DIMENSION V(1:IMAX)
      REAL VMAX
C
      VMAX=0.0                    ! Initialize highest V-coordinate of outline
      QMAX=0                            ! Initialize counter
C
      DO 10, I=1,IMAX
        IF (V(I).GT.VMAX) THEN
          VMAX=V(I)
         QMAX=I                   ! Determine the index that belongs to VMAX
        END IF
 10   CONTINUE
C
      RETURN
      END
```

Test output using interpolated outline 503A011080K0701_INT with 250 points:


Output Program Resort1
503A011080K0701_INT
MAX=250
Interpolated Y (µm)
Interpolated X (µm)
600
400
200
0
-200
-400
-600
-600 -500 -400 -300 -200 -100 0 100 200 300 400 500 600
Original outline (_INT file)
Start original outline
Resorted outline
Start resorted outline (Ypmax)