# Integral of Lagrange polynomial

Consider the Fourier transform from begr to endr of a function defined as a Lagrange polynomial.

The function through these points is


 The integral of f is



 The Integrals are of the form



Define and let so that the integral becomes

 Define 

So that







The integral is



The code to integrate from the first point to the last in Fortran is in [for\AINT.FR](for%5CAINT.FOR)

 FUNCTION TAINT(XDAT,FDAT,N)

 IMPLICIT REAL\*8 (A-H,O-Z)

 DIMENSION XDAT(\*)

 COMPLEX\*16 FDAT(\*)

C EVALUATES THE INTEGRAL FROM XDAT(1) TO XDAT(N)
C LAGRANGE POLYNOMIAL THROUGH THE NEAREST 4 POINTS

 BEGR=XDAT(1)

 ENDR=XDAT(3)

 IF(N.LE.4)THEN

 IF(N.LT.4)THEN

 PRINT\*,' AT LEAST 4 POINTS ARE NEEDED FOR'
 PRINT\*,' INTERPOLATION'

 READ(\*,\*)ITEST

 STOP

 ELSE

 ENDR=XDAT(4)

 ENDIF

 ENDIF

 TAINT=AINT2(XDAT(1),XDAT(2),XDAT(3),

 A XDAT(4),BEGR,ENDR

 2 ,FDAT(1),FDAT(2),FDAT(3),FDAT(4))

 IF(N.EQ.4)RETURN

 DO I=3,N-3

 BEGR=XDAT(I)

 ENDR=XDAT(I+1)

 TAINT=TAINT+

 2 AINT2(XDAT(I-1),XDAT(I),XDAT(I+1),XDAT(I+2),BEGR,ENDR,

 3 FDAT(I-1),FDAT(I),FDAT(I+1),FDAT(I+2))

 ENDDO

 BEGR=XDAT(N-2)

 ENDR=XDAT(N)

 TAINT=TAINT+

 2 AINT2(XDAT(N-3),XDAT(N-2),XDAT(N-1),XDAT(N),BEGR,ENDR,

 3 FDAT(N-3),FDAT(N-2),FDAT(N-1),FDAT(N))

 RETURN

 END

 FUNCTION AINT2(SA,SB,SC,SD,BEGR,ENDR,FA,FB,FC,FD)

 IMPLICIT REAL\*8 (A-H,O-Z)

 COMPLEX\*16 FA,FB,FC,FD

 H=ENDR-BEGR

 XMID=(BEGR+ENDR)/2

 AINT2=FA\*AIHAT2(SB,SC,SD,H,XMID)/((SA-SB)\*(SA-SC)\*(SA-SD))

 2 +FB\*AIHAT2(SA,SC,SD,H,XMID)/((SB-SA)\*(SB-SC)\*(SB-SD))

 3 +FC\*AIHAT2(SA,SB,SD,H,XMID)/((SC-SA)\*(SC-SB)\*(SC-SD))

 4 +FD\*AIHAT2(SA,SB,SC,H,XMID)/((SD-SA)\*(SD-SB)\*(SD-SC))

 RETURN

 END

C

 FUNCTION AIHAT2(SB,SC,SD,H,XMID)

 IMPLICIT REAL\*8 (A-H,O-Z)

 CAPB=(XMID-SB)

 CAPC=(XMID-SC)

 CAPD=(XMID-SD)

 AIHAT2=H\*(CAPB\*CAPC\*CAPD+H\*H\*

 2(CAPB+CAPC+CAPD)/12)

 RETURN

 END

# Any function can be found using findfun and integrated by the above to yield

In the above let so that



The function G is known on the grid of points found by findfun. In a general integral of the form



make the variable change **using a positive definite g**



Then

