3D Environment - Fortran

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Version 1.00 May 27th, 2025

Link: https://ftp.setterholm.com/3DEnvFortran/3DEnvFortran.pdf
Save as: 3DEnvFortran100.pdf

My Fortran source code herein is all free.
Syntax-color-coded source .pdf files are online.

The PhilosophyWorks®
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https://setterholm.com

Individual cognition is always flawed -&- Lawyers abound, so…
Use this environment at your own risk.

My website's existing related content was written in "C":

```
3DEnv.exe - June 24,2016+

My goal is to provide insights
    into the mathematics of
3D-stereo homogeneous vector graphics
  to help synergize & standardize
    the visual component of
tomorrow's human/computer interfaces.
```

This source code naming convention is "S_" and the Fortran app is "Sn3D.exe".

All the content is accessible online:
https://ftp.setterholm.com/3DEnvFortran has

```
05/27/2025  08:58 AM           158,208 3DEnvFortran.pdf  <-this document
05/26/2025  09:01 PM             2,386 Zip-Directory.txt
And subdirectories:
```

/Sn3D	- the entire Fortran environment
/Sn3D/ColorCodedSource-pdf	- the color-coded Fortran source files
/Sn3D/Images	- images & a function key template

The compressed download is: : https://ftp.setterholm.com/3DEnvFortran/Sn3D.zip
Download this file to your computer and "extract" the contents. Typically the extracted files are in subdirectory "/Sn3D". In that subdirectory **change** "Sn3D.exf" to "Sn3D.exe" which Windows 10 refers to as an 'application". If and when you decide to run Sn3D.exe for the first time, seek assistance from someone familiar with DOS/Windows programming and "console applications". **When the program is running, enter "q" –or- "Q" to quit**/exit.

Why bother:

Imagine:
In kindergarten every student receives a tiny solar-powered computer that self-contains all of the K-12 curriculum, the definitive personally-usable rulebook, a wealth of CAD tools, and a simulation & 3D visualization programming environment. The computer's content is free, i.e./e.g.: not anyone else's restricted intellectual property.

The 3D visualization component allows intuition to assess processes & outcomes in many more dimensions than particular subjective assessments can achieve. Intuition, persistence & dumb luck underlie constructive progress. This Fortran code offers background material for anyone interested in creating the excellent simulation & 3D visualization environment.

Use red:cyan 3D glasses to view the opening screen shot below. Sn3D.exe running in a Windows 10 environment with a 4K monitor:

Sn3D has a help screen which is accessed by entering "H". The fixed part of the screen introduces the software in the following way:

```
      The `H`/`h` (=Help) key toggles this screen information.

These algorithms support split screen left|right & right|left, and also
  a full screen display mode, with orthographic, perspective, & stereo
  viewing options in each display mode. [The gem of code underlying this
  functionality is subroutine ViewGeom in file S6View8.f95.] Apps are
  called from within this live double-buffered environment.

Pressing `P` hardcopies the homogeneous projection(s) to Sn3D-Out.txt,
  while  `p` prints them on the DOS screen, which can be viewed
  by toggling the `Escape` key. Writes to unit#`Up` are reported during
  that iteration, simplifying at-will focused quantitative snapshots of
  your algorithms in action.

Nutation is toggled by `Nn`, yielding monocularly-perceivable depth.

In simulations, rigid bodies often have 6 Degree-of-Freedom ("=6DoF")
  motion (X,Y,Z,Roll,Pitch, & Yaw); herein Standard Flight Simulation
  Coordinates are used (+X:forward, +Y:right, +Z:down, etc.). In viewing
  your particular point-of-interest ("PoI"), magnification is added
  as the 7th DoF. Exterior control of PoI is also implemented (`9`).

The numeric keypad and mouse (LMB-down) provide interactive control of
  the 6DoF and 7Dof states. E.g.: Left-click a DoF name to select it.
Keyboard keys:            Apps Access:              Simulation Ctls:
  Cc:Screen Color           F1:Application Stub       F 9:Reset
  E : display mode          F2:Dodecahedron Vis.      F10:Hold
    =0:  full    screen     F3:                       F11:Run
    =1:Left|right split     F4:                       F12:Stop
    =2:right|left split     F5:                       ...runs RunTimer
   e: projection            F6:                        & sets SimMode
    =0:orthographic         F7:                       for your convenience.
    =1:perspective          F8:PixelDraw
    -2:stereovision                Turn NumLock on!
  Hh:help screen          Numeric keypad 6DoF & 7DoF control:
  M :8 free Mchan[0.,1.]`s  1:X                     Left Mouse Button=LMB
   m:7Dof/6Dof toggle       2:Y                     and arrow keys
  Nn:2 model Nutation modes 3:Z                     can also be used.
  P :Print to-.txt file     4:Roll
   p:         -DOS screen   5:Pitch                 See onscreen summary.
  Qq:Quit                   6:Yaw
  Tt:7 Teapot views         7:Mag                    The teapot is an
  Vv:2 Viewing info modes   8:Reset 1:7             example 7DoF object.
                            9:Interior/Exterior PoI control
                            0:Resets most recently selected DoF #1
Sn3D.exe  V1.0  2025.05.24                                In S1ModDef @L665+
```

My key takeaway from 50 years of scientific programming is that clear variable definitions lie at the core of "the wisdom of hindsight". Concentrating on defining variables carefully at the beginning of solving a problem is time well spent. This approach played out extremely well for the scientific thinkers centuries ago… "meter", "kilogram","second", etc.; presto: technical focus became a reality. (In contrast, "free" is in the vast pantheon of unfocused English social word.)

This source code, "Sn3D", collects the key variables in the first file "**S1ModDef.f95"** & separates various simulation functionalities in the subsequent files. The same help screen shown above has a scrollable portion which overviews the source code files as shown on the next three pages:

```
`S8Help.txt`              2025.05.27.1125cdt JMS                  Lines:194
  IP Status- Free source code (e.g.: post copyright)
     Author- Jeffrey M. Setterholm, Lakeville,MN 55044 USA
        *** No warranties are expressed or implied. ***
_____________________________________________________________________________
This source code is approximately Fortran 95 with f90gl graphics which
  builds and runs on a Windows 10 computer as a `console` application
  with various full-screen ~ DOS windows.

In Absoft Pro Fortran 21.0.2 there are two "glut32.dll"`s ("dynamically-
linked libraries") with identical names that are not interchangeable files!

Use this file with Sn3D.exe in Windows 10:
date  &     time      Size(bytes) Name
11/01/2020  05:52 PM  258,736     glut32.dll  For the 32-Bit executables

Do not use this file with Sn3D.exe:
date  &     time      Size(bytes) Name
11/01/2020  05:54 PM  307,376     glut32.dll  For the 64-Bit executables
            note: slightly larger & created two minutes later.

_____________________________________________________________________________
A subdirectory of color-coded .pdf's of the source code is also included.

!-- Data Structures/Modules:
05/24/2025  07:53 PM            42,353 S1ModDef.f95                   Group#1
! Module OpenGLRec          !Ref: OpenGL GL/GLU/GLUT Documentation
! Module TaskDef            !Project/Context
! Module ioDef              !Files,Units,TimeStamp,Selfies,Flags
! Module ScreenDef          !screen & colors
! Module KeyboardDef        !Keyboard
! Module MouseDef           !Mouse
! Module ViewDef            !View bounds->[0.,+1.]->[extent]Destination
! Module ModelDef           !Modelview Matrix Generation
! Module SimDef             !Simulation F9-F12
! Module HelpDef            !Help (a text block)
! Module AppsDef            !User Apps F1-F8
! Module F3dvDef            !File .3dv data
! Module BreakPtDef         !BreakPoint & Scrolling
! Module UseAllBbDef        !Contents

05/24/2025  07:47 PM            15,393 S2ModCallbacks.f95             Group#2
!Module S2Callback                    This directly interfaces with OpenGL
! Subroutine cbUserView                                !Called by: OpenGL
! Subroutine cbKeyboard(Key,xCursor,yCursor)                "     :   "
! Subroutine cbSpecialFunctionKeys(Key,xCursor,yCursor)     "     :   "
! Subroutine cbMouseMotion(iX,iY)  Active & Passive         "     :   "
! Subroutine cbMouseButtons(Button,State,iX,iY)             "     :   "
! Subroutine GlutHandoff                                    "     : S3Main.f95
! Subroutine CheckGL(Line)    ...checks for OpenGL errors             ^: once
!End Module S2Callback               referenced by Group#

!-- Subroutines & Functions:
05/24/2025  06:50 PM            34,962 S3Main.f95                     Group#3
! Program    S3Main                  Main calling program & utilities
! Subroutine BreakHere(iP,Label)
! Subroutine jPause(Label)
! Subroutine SaveOutFile
! Subroutine M44V4multh(V4outh,Matrix44,V4inh,iP)
! Subroutine M44multh(M44outh,M44Linh,M44Rinh,iP)
! Subroutine h44Fill(Hout,A,B,C,D,E,F,G,H,I,J,K,L,M,N,O,P)
! Subroutine Invertr8(N,MatrixIn,MatrixOut,iP)
! Subroutine Invertr16(N,A,ValMin,iRank,DetN,iUsed,iP)
! Subroutine Printr16(N,A,Noise,iRank,DetN,iRu,jCu,iP)
! Subroutine Rand16(n,Xrandom,iP)
! Subroutine X12Y12toMB(X1,X2,Y1,Y2,M,B,iP)
```

```
! Subroutine Eval(Stage,Descr1,Descr2,Value1,Value2,iP)
! Subroutine DaTime18
! Subroutine RunSeconds
! Subroutine PixelDraw                                                = AppF8
! Subroutine nRunSec(nClock,RunSecs,iW)
! Subroutine Jdate20(DaTime)

05/24/2025  06:46 PM             5,831 S3Main-CallYourApps.f95       Group#19
! Subroutine CallYourApps              This is the user interface to Sn3D
! Subroutine ImportYourNml

05/24/2025  07:55 PM            25,795 S4Callbacks.f95               Group#4
!*Subroutine UserView                 interface to S2ModCallbacks.f95
!*Subroutine Keyboard(Key,xCursor,yCursor)
!*Subroutine SpecialFunctionKeys(Key,xCursor,yCursor)
!*Subroutine MouseButtons(Button,State,iX,iY)
!*Subroutine MouseMotion(iX,iY)
! Subroutine MouseRecUpdate(md)
!*= directly called by the S2 OpenGL callback subroutine passthroughs.

05/24/2025  07:46 PM            43,334 S5Screen.f95                  Group#5
! Subroutine PrntOrtho(nRow,mColumn,iColorFG,iColorBg,PText)
! Subroutine PrintableIchar(iCharIn,iCharOut)
! Subroutine Seeh4d(Vin,nRowIn,nColIn,iColor,Label,iP)
! Subroutine Seeh44d(Hin,nRowIn,nColIn,iColor,Label,iP)
! Subroutine Teapot
! Subroutine Colors3D(nCol)
! Subroutine ScreenSelfie
! Subroutine ShowProjectAndModel(nRowIn,nColIn,iColor,Label20)
! Subroutine HfsToHgl(Hfs,Hgl)
! Subroutine HglToHfs(Hgl,Hfs)
! Subroutine GLv16toHgl(GLv,Hgl)
! Subroutine BbFog

05/24/2025  07:46 PM            24,940 S6View8.f95                   Group#6
! Subroutine View                      Homogeneous-transform-intensive 3D
! Subroutine ViewGeom(iP)
! Subroutine UnPackCv(Cv,D,E,N,F,L,R,T,B,Mx,Bx,My,By,Mz,Bz)
! Subroutine UnPackDv(Dv,N2,F2,L2,R2,T2,B2,Mi,Bi,Mh,Bh,Mv,Bv)

05/24/2025  07:46 PM            47,428 S7Motion7.f95                 Group#7
! Subroutine Motion7(nM7,iEye,iP)      Managing 7 degree-of-freedom ops
! Subroutine hPoIGen(hPoI,XyzRpyM,Mode,iP)                    & mouse magic
! Subroutine hPoIDecode(hPoI,PoI7,iP)
! Subroutine hFS7Gen(hFS7,XyzRpyM,iP)
! Subroutine hFS7Decode(hFS7,FS7,iP)
! Subroutine DCfromRPY(DC,RPY,iP)
! Subroutine OddEven7DoF(ioe,ioein,ioeu,DoFsInUse,iP)
! Subroutine PackM7u
! Subroutine UnPackM7u
! Subroutine CubeGrid(nCol)
! Subroutine WirePlane(Sizeu,nCol)
! Subroutine VecFont7(XYZRPYwC,LineWidth,iCol,Label)
!--Quaternions:
! Subroutine QFromRpy(Q,Rpyh)
! Subroutine QoutFromQoQi(Qout,Qo,Qi)
! Subroutine QtoRpy(Q,Rpy)
! Subroutine QToQinverse(Q,Qinverse)
! Subroutine QtoVhatAngle(Q,Vhat,Angle,iP)   <-"JeffTernions"

05/24/2025  07:45 PM            19,632 S8Help.f95                    Group#8
! Subroutine Boilerplate(iDetails)
! Subroutine TextToScreen(HelpFileIn,nRowIn,nColIn,iColor,iP)
05/24/2025  08:29 PM             8,550 S8Help.txt   <-which is shown here.

05/24/2025  07:49 PM            39,542 S9Font.f95                    Group#9
! Module CharDef
!  ~an English character vector font, & more.
! End Module CharDef
! Subroutine AlphaJS(cLabelL,PosLLCq,RpyDq,SizeHq,iCol,fLineWidth,iP)
```

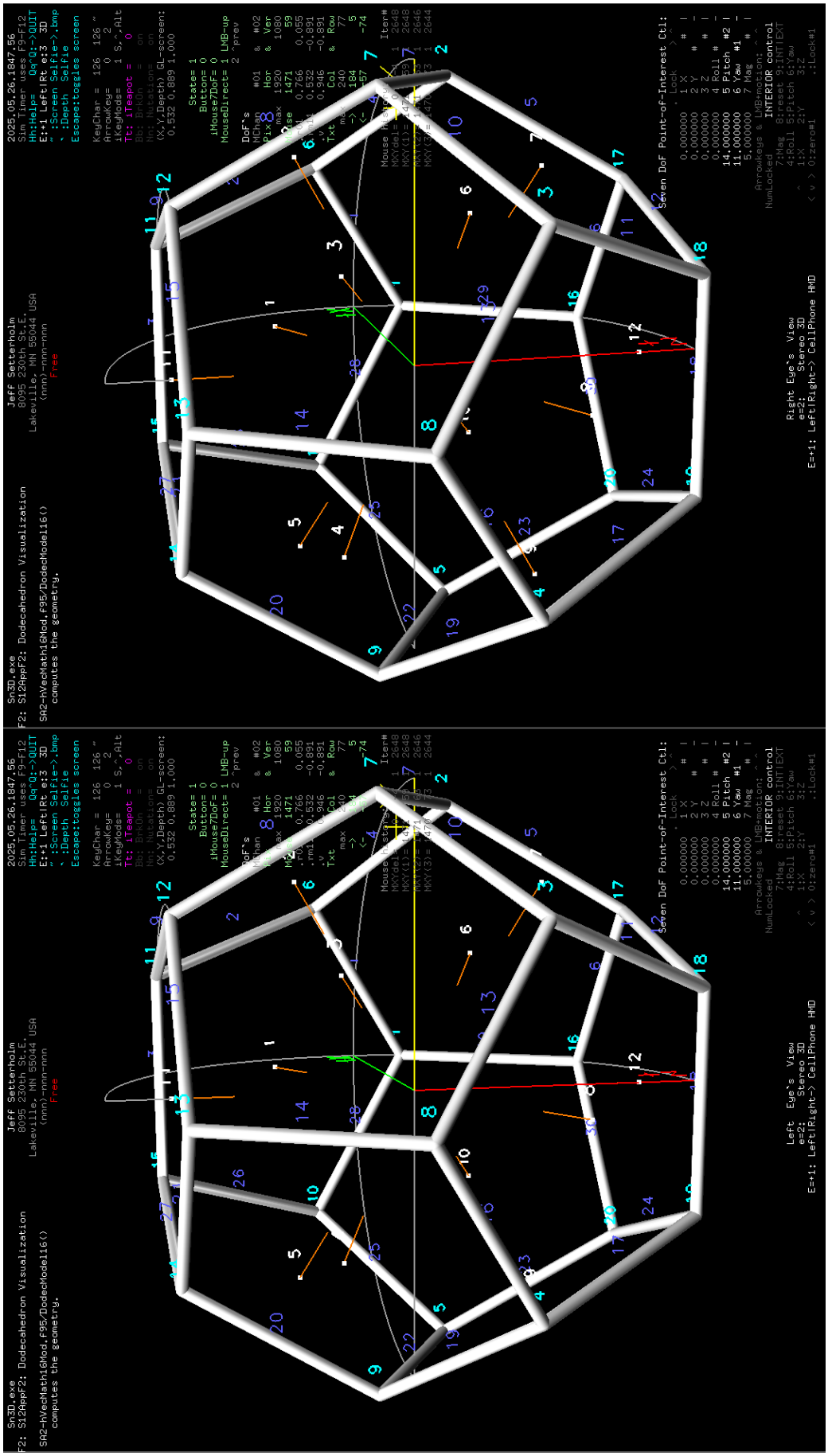
```
! Subroutine Model7DoF(Xyzh,Rpyh,S,Model7h,iP)
!---------------------
!-- Auxiliary subroutines - Basic real(8) homog. vector math
05/24/2025  07:50 PM             9,550 Sa-Mathh8Mod.f95
!Module hVecMath8Mod
! contains
!  Subroutine hAdd(Vouth,V1h,V2h)
!  Subroutine hSubtract(Vouth,V1h,V2h)
!  Subroutine hCross(Vouth,V1h,V2h)
!  Subroutine hDot(V1h,V2h,DotP)
!  Subroutine hVnorm(Vinh,Vouth,Vmag)
!  Subroutine hPointPolar(Ph,aRpyh,PDmag)
!End Module hVecMath8Mod

!-- Auxiliary subroutines - Draws glistening tube-lines
05/24/2025  07:51 PM            20,589 Sa-TubesMod.f95
!Module TubeDef
! type,public::TubeRec:Tu(:),TuIn,TuZero
! type,public::LightMaterialRec  ;sequence
! contains
!  Subroutine Lighting(iOffOn)
!  Subroutine LightShow
!  Subroutine Material
!  Subroutine Tubes(iDone,nPoint,pXyzh,Radius,iP)
!  Subroutine Sphere(SphRad,pXyz)
!End Module TubeDef

_____________________________________________________________________________
!-- Application#1 - S11AppF1: Application Stub                +10 = Group#11
05/24/2025  06:40 PM            11,721 S0-AppF1-stub.f95
! Subroutine S11AppF1
_____________________________________________________________________________
                       *** Dodecahedron Visualization ***
!-- Application#2 - S12AppF2: Dodecahedron Visualization      +10 = Group#12
05/24/2025  06:39 PM            14,028 S0-AppF2-Dodec.f95
!Subroutine S12AppF2
!Subroutine PLabelView(A3,P3L,iCol,WidthOfLine)

05/24/2025  08:29 PM            47,585 SA2-hVecMath16Mod.f95
!Module hVecMath16Mod
! Module DodecIO                                <- dodecahedron analysis variables
! contains
!  Function Sqrj(Valin) Result(ValSqrout)                        2025.04.21.1545
!End Module DodecIO
!Subroutine DodecModel16(iP)                        <- dodecahedron geometry math
!Subroutine SinCos16(AngleD,SinAngle,CosAngle)
!Subroutine ASinD16(Angle,SineAngle,iP)
!Subroutine ACosD16(Angle,CosineAngle,iP)
!Subroutine hPointPolar16(Ph,aRpyh,PDmag)
!Subroutine hVnorm16(Vinh,Vouth,Vmag)
!Subroutine hVecMirror2D16(Vinh,Vmirrorh,Vouth)
!Subroutine hVecMirror3D16(Vinh,Vmirror1h,Vmirror2h,Vouth)
!Subroutine hCross16(Voh,Vi1h,Vi2h)
!Subroutine Sqrt16(ValIn,ValSqrOut,iP)
_____________________________________________________________________________
!-- Application#8 - AppF8:  Colors Visualization              +10 = Group#18
      located in : S3Main.f95 @L694:  Subroutine "PixelDraw"
!---------------------
```

The “F2” function key accesses the dodecahedron visualization. A “~” screen shot in Left:Right 3D suitable for a cell-phone based 3D viewer is shown on the next page. The split screen could have been decluttered by typing “V”:



An Absoft Fortran's Graphical User Interface screenshot:

Microsoft Corp. controlled Absoft Corp. for ~ a decade before the company closed. Seriously consider restoring the Absoft Fortran programming environment as a public domain analytical & visualization tool.

This concludes my version 1.0 introduction to the Sn3D environment.