Appendix H
Supplementary EIT Code `EITFUL.F`

The supplementary Fortran 77 code `EITFUL` by J. R. Torczynski produces complete, axisymmetric "experimental" datasets from fundamental voltage solutions. These datasets may be used to validate reconstruction algorithms such as `EITAXI` or may be used for other verification work.

`EITFUL` uses two properties of the fundamental voltages to compute axisymmetric datasets. First, because the fundamental voltage solutions are computed from axisymmetric domains, the voltages are rotationally invariant. For the case of current injection at electrode i, withdrawal at electrode j, and voltage determined at electrode m, the domain conductivity distribution (or, equivalently, each of the electrode indices) may be azimuthally rotated by any value without altering the boundary voltages.

$$V_m^{(ij)} = V_{m+1}^{(i+1,j+1)} = V_{m+2}^{(i+2,j+2)} \ldots \tag{H.1}$$

Second, the system of FEM equations describing the boundary voltages is linear, so that fundamental voltage sets for two related injection-withdrawal combinations may be added to obtain the fundamental voltage sets for a third combination. If the fundamental voltages are known for the case of injection at electrode a and withdrawal at electrode b, and also for injection at b and withdrawal at c, then

$$V_m^{(ab)} + V_m^{(bc)} = V_m^{(ac)} + C \tag{H.2}$$

Given a combination of values for a, b and c, a single value of the linearity constant C applies for all measurements m in the dataset.

The input file `eitful_inp.dat` is identical to the first five lines of `eitaxi_inp.dat` in Appendix F. The data file `eitful_sol.dat` contains the fundamental voltages in the order V_0, V_1, ..., V_8 (injection electrode last). The output file `eitful_exp.dat` contains the "experimental" dataset and follows the standard format shown as `femeit_exp.dat` in Appendix E.

```
c
c234567890123456789012345678901234567890123456789012345678901234567890123456789012
c
      program eitful
c
```

```
c     Revision 19990419
c
c *** Produces full EIT experimental data set
c     from axisymmetric fundamental solution.
c
      implicit double precision (a-h,o-z)
c
      parameter (nfun=8)
      dimension vfun0(0:nfun)
c
      parameter (nelc=2*nfun)
      dimension vk0(nelc)
      dimension vkm0(nelc,nelc)
      dimension vkmn0(nelc,nelc,nelc)
c
 1001 format (1x,d18.12)
 1002 format (1x,i4)
 1003 format (3(i2,1x),3(d18.12,1x))
 2000 format (1x,a)
 2001 format (1x,a12,d18.12)
 2002 format (1x,a12,i4)
c
c *** Read in input parameters.
c
      write (6,2000) 'Reading input parameters from eitful_inp.dat'
      open (unit=23, status='old', file='eitful_inp.dat')
      read (23,*) convrt
      read (23,*) hoverr
      read (23,*) radius
      read (23,*) curr12
      read (23,*) sigma0
      close (unit=23)
c
      vltref = curr12 / ( convrt * hoverr * sigma0 * radius )
      vltcon = 1. / vltref
      write (6,2001) '   convrt = ', convrt
      write (6,2001) '   hoverr = ', hoverr
      write (6,2001) '   radius = ', radius
      write (6,2001) '   curr12 = ', curr12
      write (6,2001) '   sigma0 = ', sigma0
c
c *** Read in the fundamental solution.
c
      write (6,2000) 'Reading fundamental solution from eitful_sol.dat'
      open (unit=27, status='old', file='eitful_sol.dat')
      do 0110 ifun = 0, nfun, 1
         read (27,*) vfun0(ifun)
 0110    continue
      close (unit=27)
c
c *** Find all experimental voltages.
c
      do 0310 ip = 1, 1+nfun, 1
         ifun = 1 + nfun - ip
         vk0(ip) = vfun0(ifun)
 0310    continue
c
      do 0320 ip = 2+nfun, nelc, 1
         ifun = ip - ( 1 + nfun )
         vk0(ip) = vfun0(ifun)
 0320    continue
c
      do 0330 ipm = 1, nelc, 1
```

```
      do 0330 ipk = 1, nelc, 1
         ip = ipk + 1 - ipm
         if (ip.le.0) ip = ip + nelc
         vkm0(ipk,ipm) = vk0(ip)
 0330    continue
c
      do 0340 ipk = 1, nelc, 1
      do 0340 ipm = 1, nelc, 1
      do 0340 ipn = 1, nelc, 1
         vkmn0(ipk,ipm,ipn) = vkm0(ipk,ipm) - vkm0(ipk,ipn)
 0340    continue
c
c *** Write out unnormalized experimental voltages.
c
      write (6,2000) 'Writing experimental data to eitful_exp.dat'
      open (unit=24, status='unknown', file='eitful_exp.dat')
      vquad = 0.
      do 0050 ip1 = 1, nelc-1, 1
      do 0050 ip2 = ip1+1, nelc, 1
         do 0040 ip = 1, nelc, 1
            vmagn = vkmn0(ip,ip1,ip2) * vltref
            vcarr = vmagn
            write (24,1003) ip1, ip2, ip, vmagn, vcarr, vquad
 0040       continue
 0050    continue
      close (unit=24)
c
c *** Write out input parameters.
c
      write (6,2000) 'Writing output parameters to eitful_out.dat'
      open (unit=26, status='unknown', file='eitful_out.dat')
      write (26,1001) convrt
      write (26,1001) hoverr
      write (26,1001) radius
      write (26,1001) curr12
      write (26,1001) sigma0
      close (unit=26)
c
c *** Completed, stop.
c
      go to 999
  998 write (6,2000) '*** ABNORMAL STOP ***'
  999 continue
c
      stop 'eitful'
      end
c
c234567890123456789012345678901234567890123456789012345678901234567890123456789012
c
```