Comparison of B-field parametrization with field maps

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Takashi's Parameterization Code

```
      real x(3), f(3), xquad(3), fquad(3), r, u, v, bz, br
      real zsol/630./, pi/3.1415927/, phi36/0.1745329/, phi16/0.3926991/
c solenoid compensating Bx field
      integer icomp/0/

c SiD anti-DID
      real a0/0.0015343/, a1/0.18476/, a2/0.050422/, a3/-0.092768/,
     -     a4/0.030064/, a5/-0.0039413/, a6/0.0001886/
      real z, zz
c
c iquad = 0 solenoid
c         1 incoming beam line quad
c         2 dump line quad
c         3 incoming beam line sextupole
c         4 incoming beam line octuple
c
      integer iquad(100)/21*0, 1, -1, 4, -4, 3, -3, 1, -1, 3, -3, 4, -4,
     - 2, -2, 2, -2, 2, -2, 2, -2, 2, -2, 2, -2, 2, -2, 53*0/
c                     b0: Q1 and Q1D magnetization
      real b0/10.5/

      f(1) = 0.
      f(2) = 0.
      f(3) = 0.
c-----------------------------------------------------------------------------
      if(iquad(numed).eq.0) then
         if(abs(x(3)).lt.zsol) then

            r = sqrt(x(1)**2+x(2)**2)

            call solenoid( x(3), r, bz, br)

            if(r.gt.0.0) then
               u = x(1) / r
               v = x(2) / r
               f(1) = br * u
               f(2) = br * v
               f(3) = bz
c-----------------------------------------------------
               if(icomp.eq.1) then
                  z= abs(x(3))*0.01
                  zz = z * z

            bx=a0+a1*z+a2*zz+a3*z*zz+a4*zz*zz+a5*zz*zz*z+a6*zz*zz*zz

                  if(x(3).lt.0.0) bx = -bx
c + DID, - DIDNT
                  f(1) = f(1) + bx
               end if
c-----------------------------------------------------
:
```

Our Interpretation

- A0 = 0.0015343
- A1 = 0.18476
- A2 = 0.050422
- A3 = -0.092768
- A4 = 0.030064
- A5 = -0.0039413
- A6 = 0.0001886

Bfield_x = | A0 + A1*z + A2*z^2 + A3*z^3 + A4*z^4 + A5*z^5 + A6*z^6 |

Process

- We were given Takashi's parameterization function and a set of files providing the magnetic field within a range of -200 to 200 (cm?). Each file corresponded to one slice along the z-axis
- We took each file and individually interpolated the points to a regularly spaced grid
- We took a collection of x,y points, and plotted the magnetic field for those x,y points at every z value, comparing them to Takashi's function

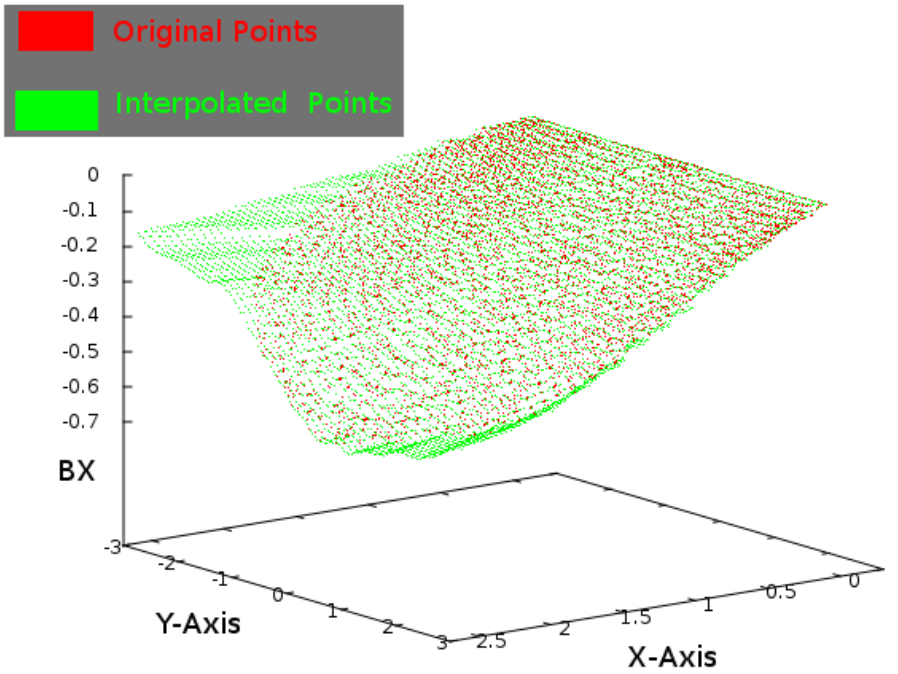
Check of SCIPP interpolation of field map

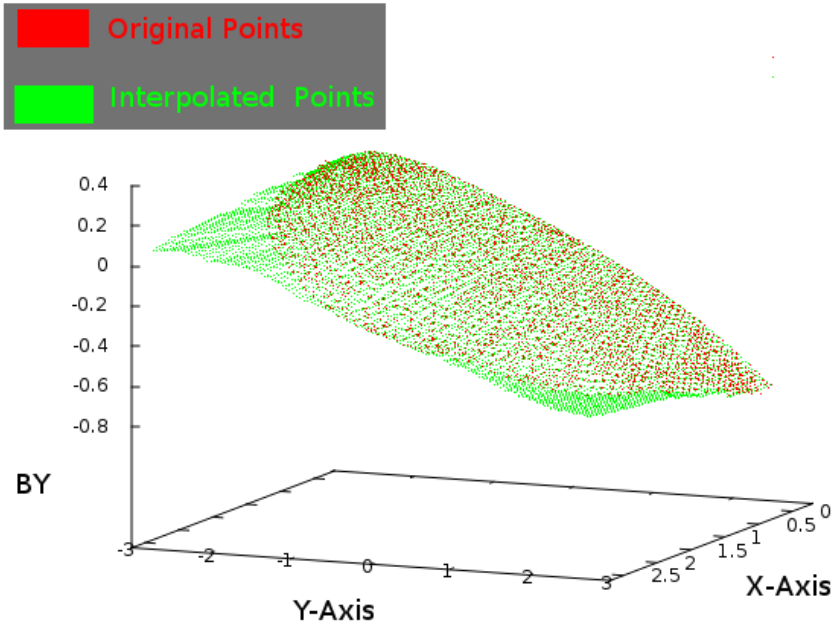
A plot of the x and y axis vs Bx, By, and Bz in turn, for a particular value of z.

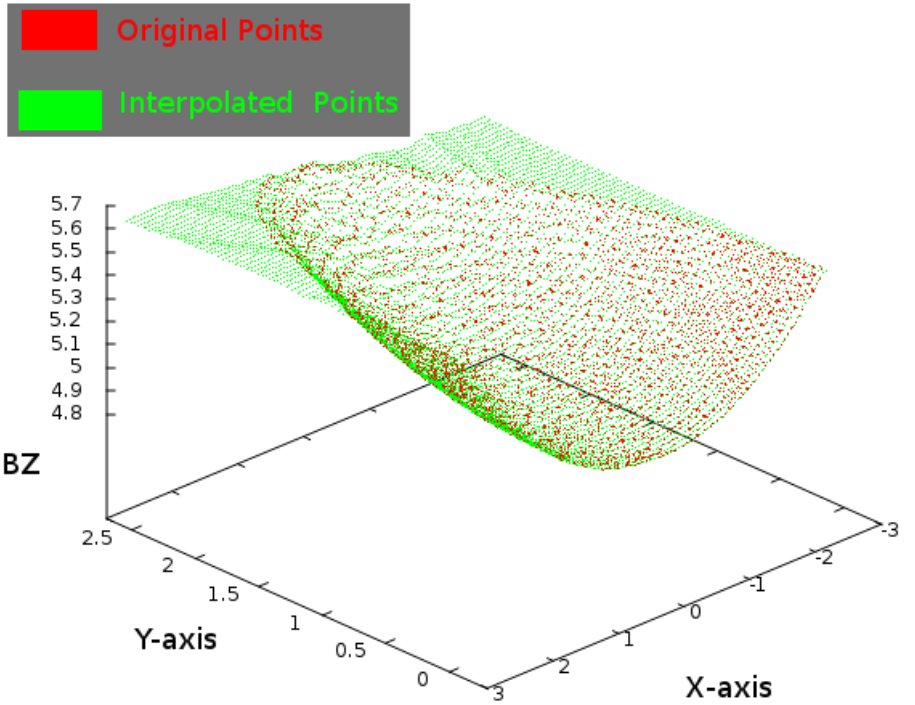
This shows that our interpolated magnetic field matches the original field.

Note that the parameterization only analyzes B_x (on right)

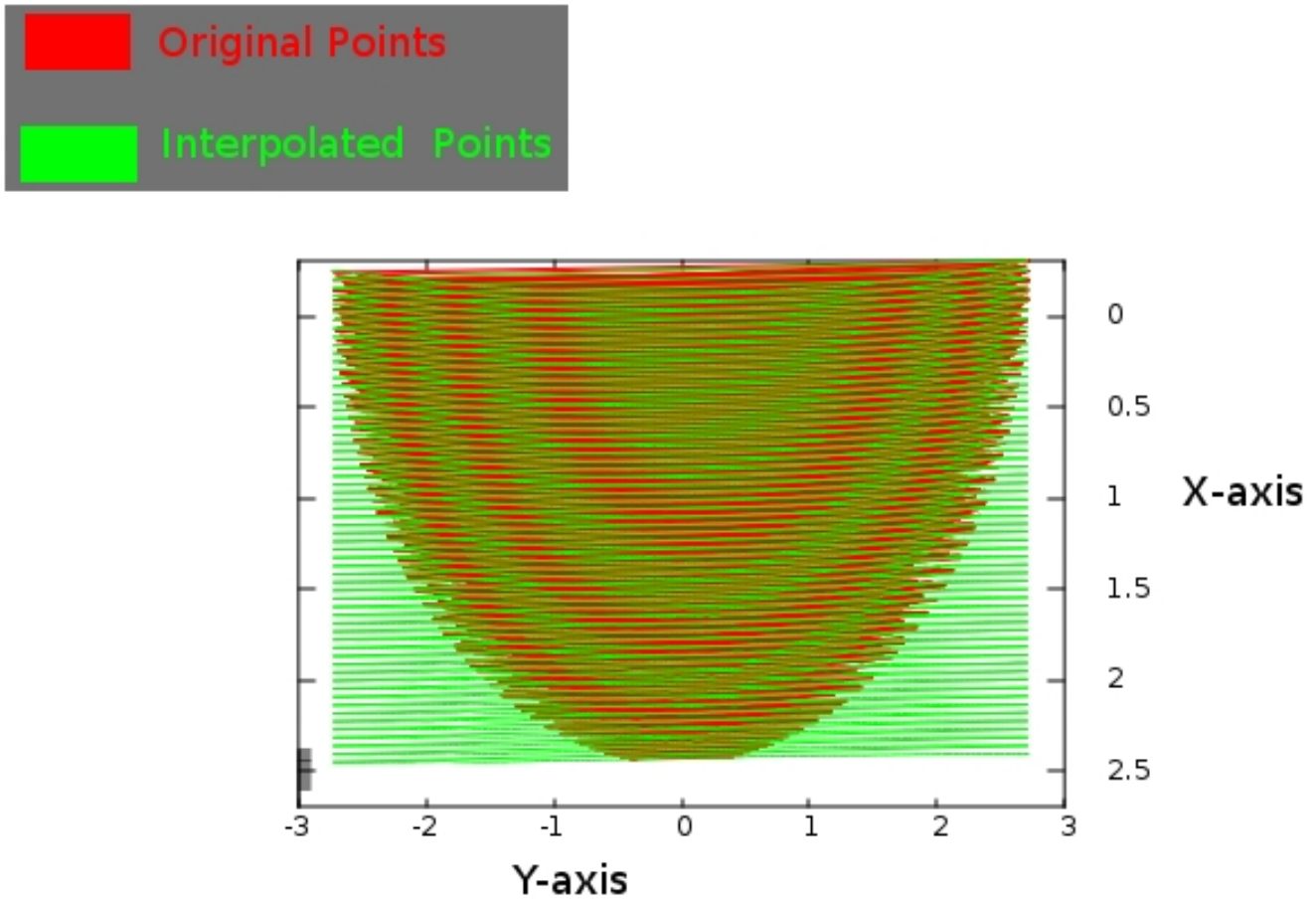
*Original Points = Field Map



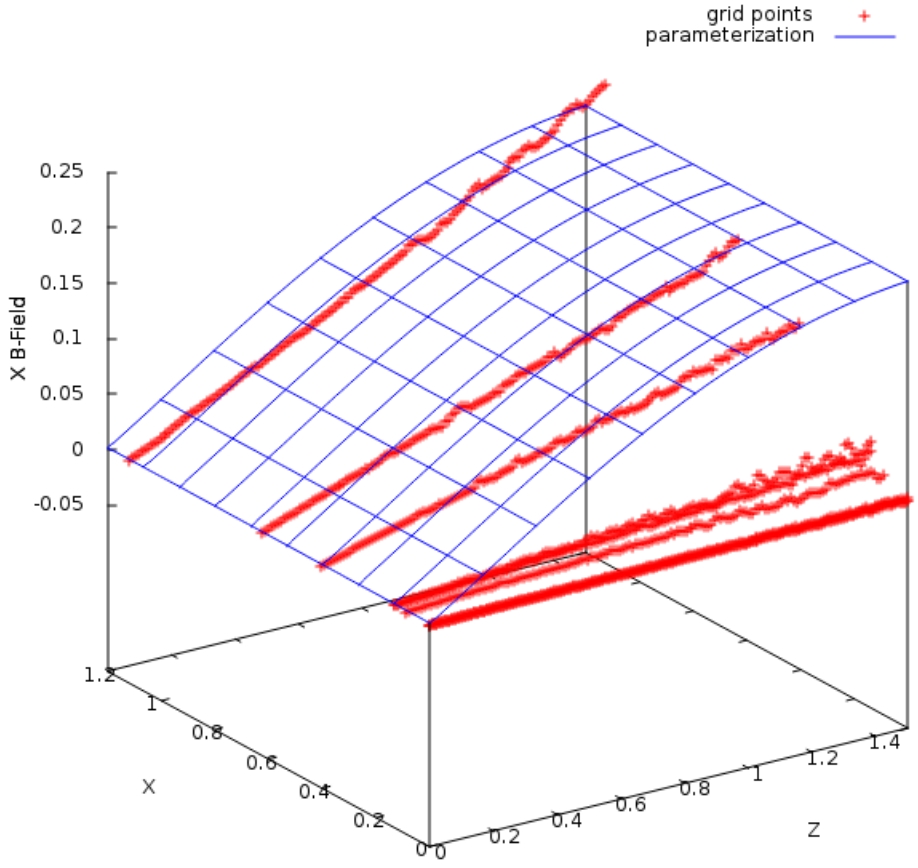


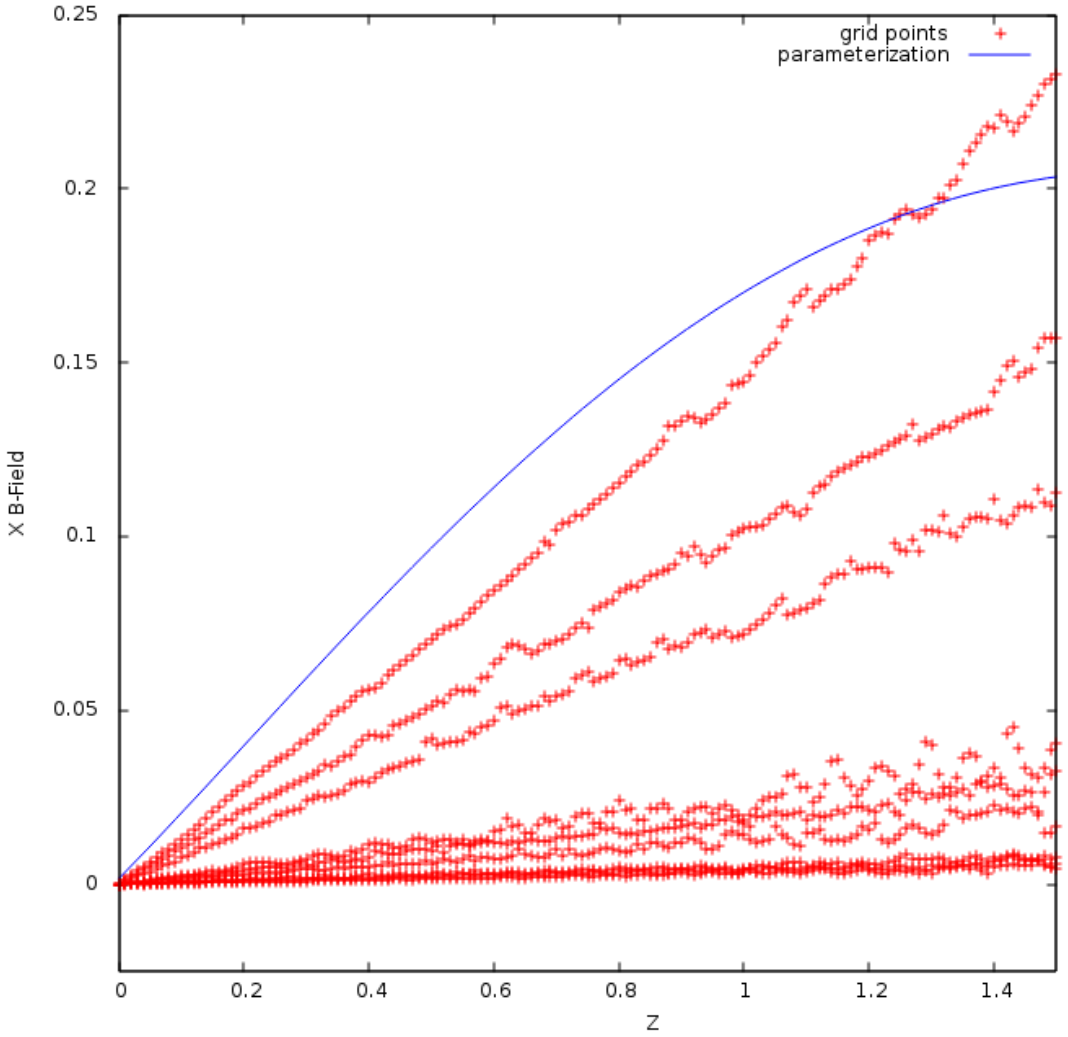


Because we used a square grid, we have points which extend beyond the actual range of the field. In our selection of x,y points to compare to Takashi's field, we only use points covered by the original files.



Comparison of interpolated points to Takashi's parameterization.





Note that Takashi's Field is mirrored across z=0, but the interpolated field continues with the same slope.

Conclusion

- The magnetic field does not line up with our interpretation of Takashi's function
- We may be interpreting Takashi's code incorrectly, or missing key information needed to use it properly
- If not, then the parameterization does not describe the magnetic field
  - The field depends on more than z
  - The field is effectively linear in z, with slopes that vary with x/y
  - The field does not reverse at negative z, but continues with the same slope