Electromagnetic field and electromagnetic wave experiment two report

稳恒电流的电场与磁场仿真实验报告

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1. 理论问题：内外半径分别为a和b的无限长空心圆柱中均匀分布轴向电流I，求柱内外的磁感应强度。



仿真模型：无限长空心圆柱轴线为z轴，内外半径分别为1mm和1.5mm，其上均匀分布轴向电流(1+adj)A，求x轴上**B**的大小。

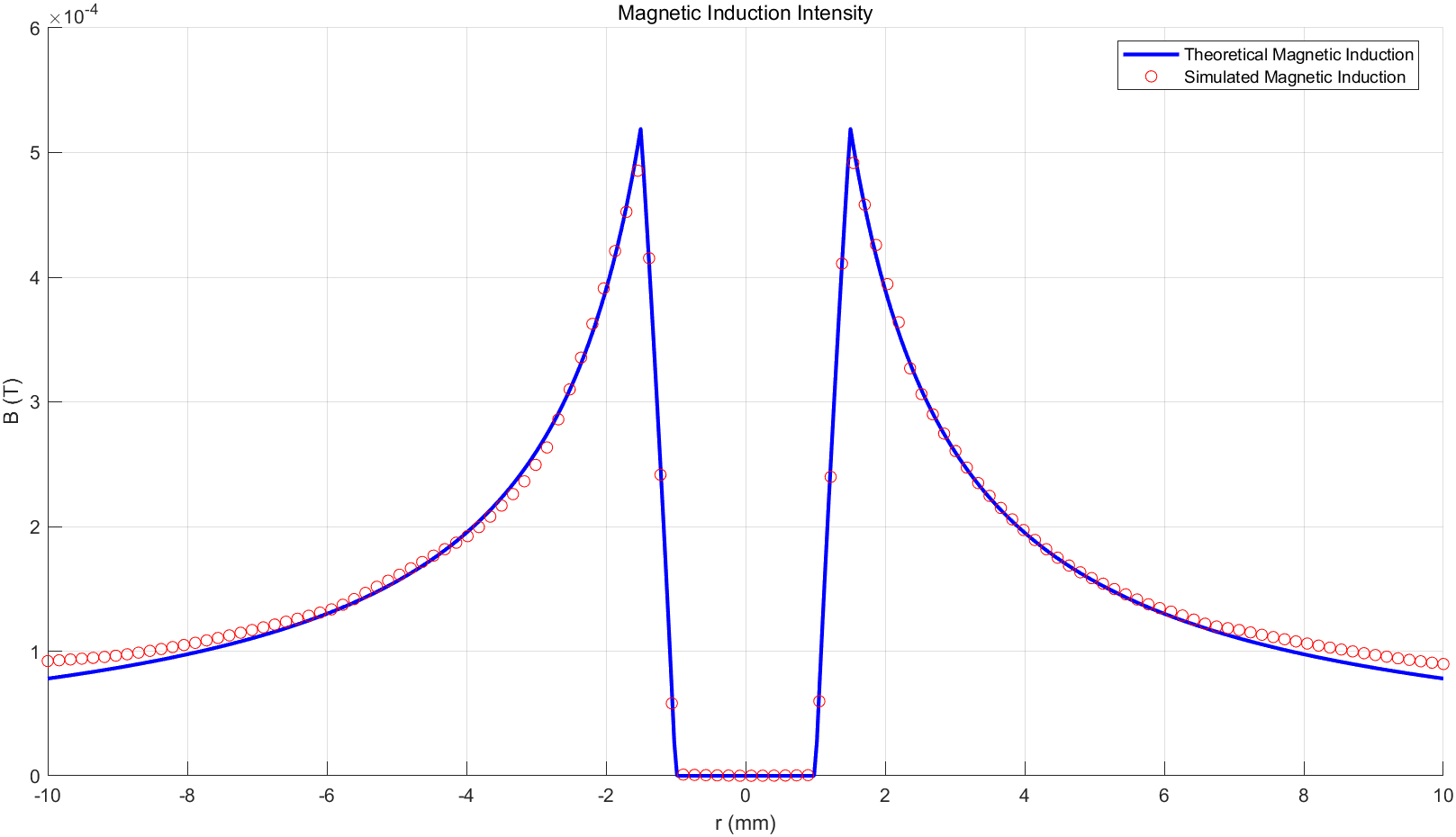


Figure 1simulation results and theoretical calculation results

1. The analysis of simulation results and theoretical calculation results

We first analyze the tendency of the B distribution for calculation and simulation value. From the figure, we observe that the B distribution is symmetrical so we only analyze the B distribution along positive x axis. When 0<=x<1.5mm, the B distribution is equal to 0. When 1.5<=x<2, the B distribution is linear increasing. When x>=2mm, the B distribution decreases by inverse proportional function.

When 0 <= x <= 2mm, the calculation value and simulation value is coincide. When x > 2mm, the front part is coincide, but with the increase of x, the simulation value is gradually larger than calculation value.

The difference may causes by the boundary condition. In the experiment, I set the boundary condition is equal to 5 for x axis and y axis respectively which is relatively small compared to the real situation. Although there exists tiny error, it is acceptable since it is impossible to absolutely simulate the real world condition.

1. 理论问题：求载流的圆形导线回路在圆心处的**B**。



仿真模型：载流的圆形导线半径为(20+adj)mm,求圆心处**B**的大小。

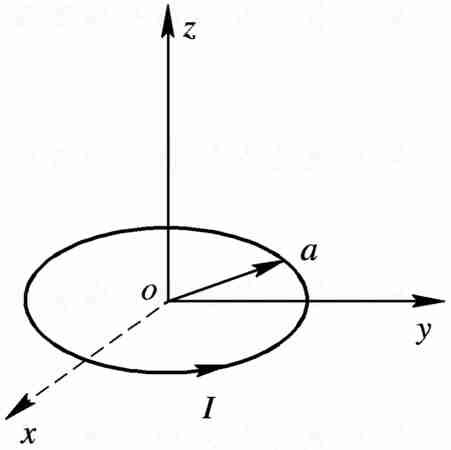


Figure 2 Diagram

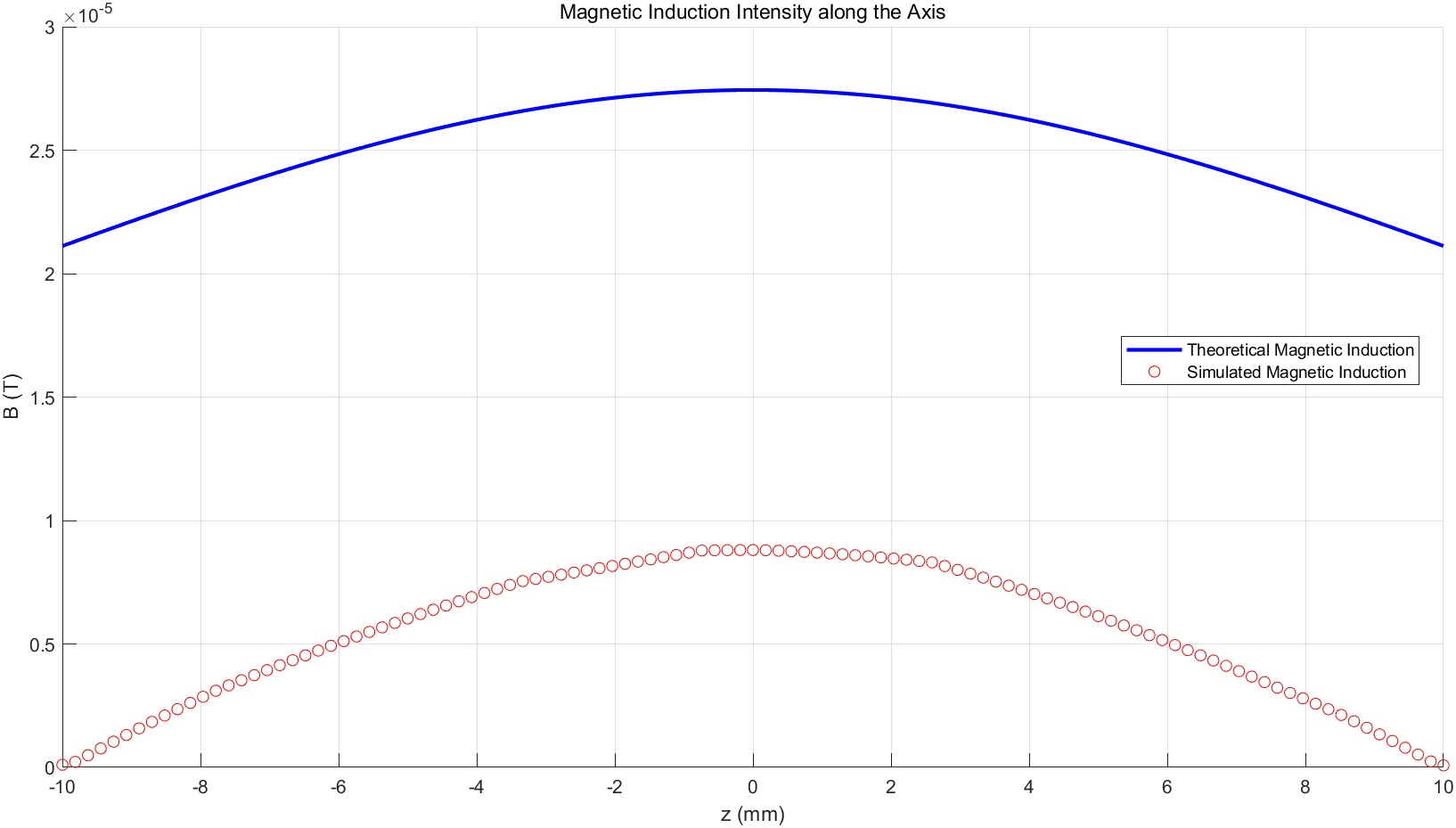


Figure 3simulation results and theoretical calculation results

There are a significant discrepancy between the theoretical and simulated magnetic induction intensity along the axis of a circular current-carrying wire. But they have the same trend of curve about up and down. There are some problem in simulation, but I can’t find it.

From the results, we can get the B of origin is max, and the other sides the B to decrease like a quadric curve.

3.同轴线内外导体半径为a，外导体的内半径为b,外半径为c，如下图。设内外导体分别流过反相的电流，两导体之间介质的磁导率为*μ*,求各区域的***H***、***B。***

若电流流向+*z*方向



仿真模型：同轴线轴线为z轴，a=0.5mm,b=1mm,c=1.5mm, 两导体之间介质的相对磁导率为(4+adj)，求x轴上的***H***、***B***。

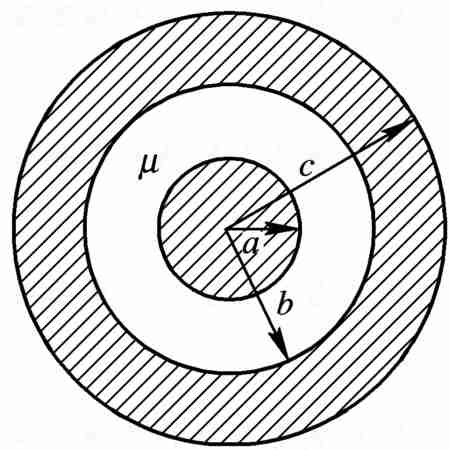


Figure 4 Diagram

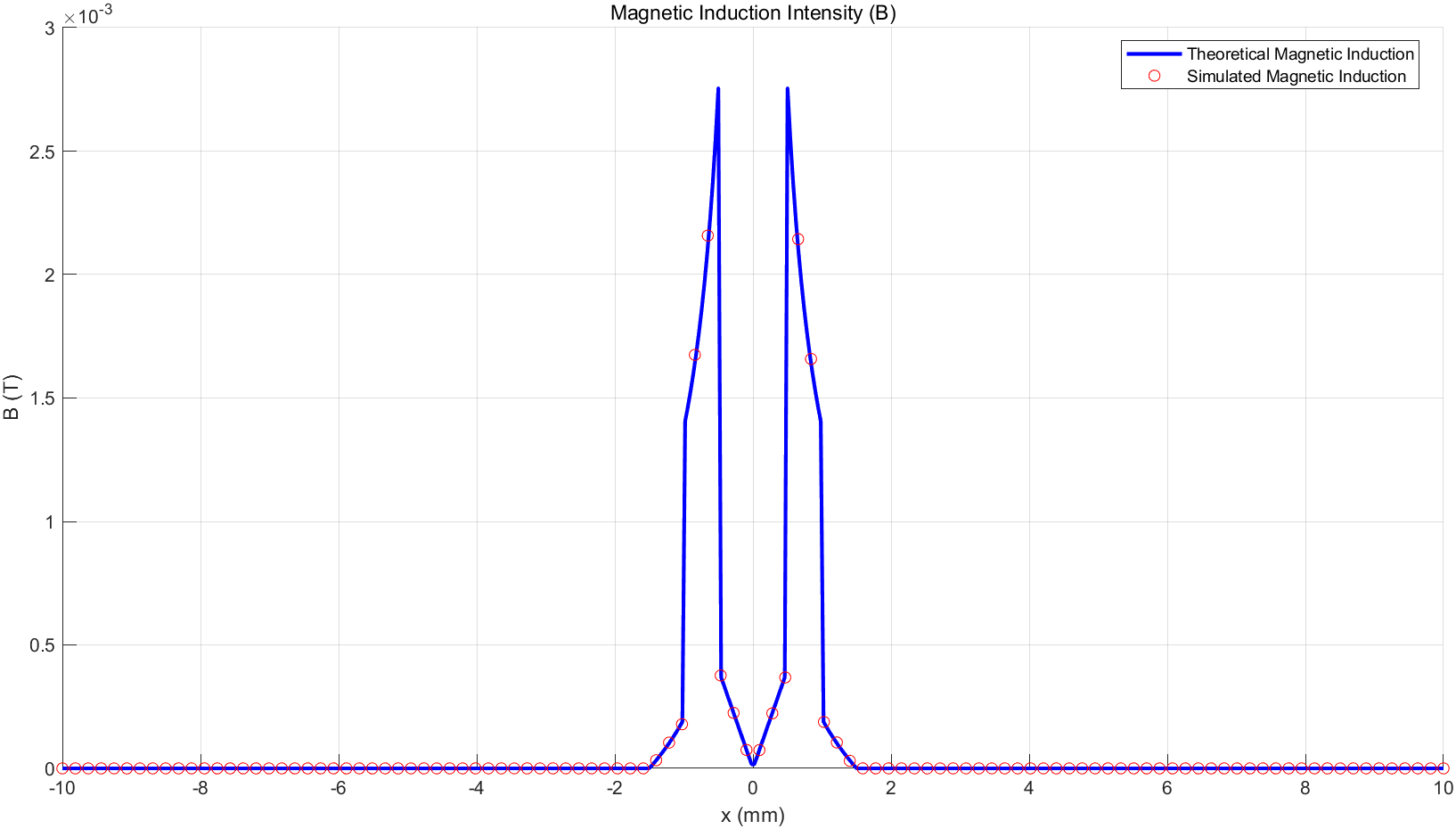


Figure 5 simulation results and theoretical calculation results for B

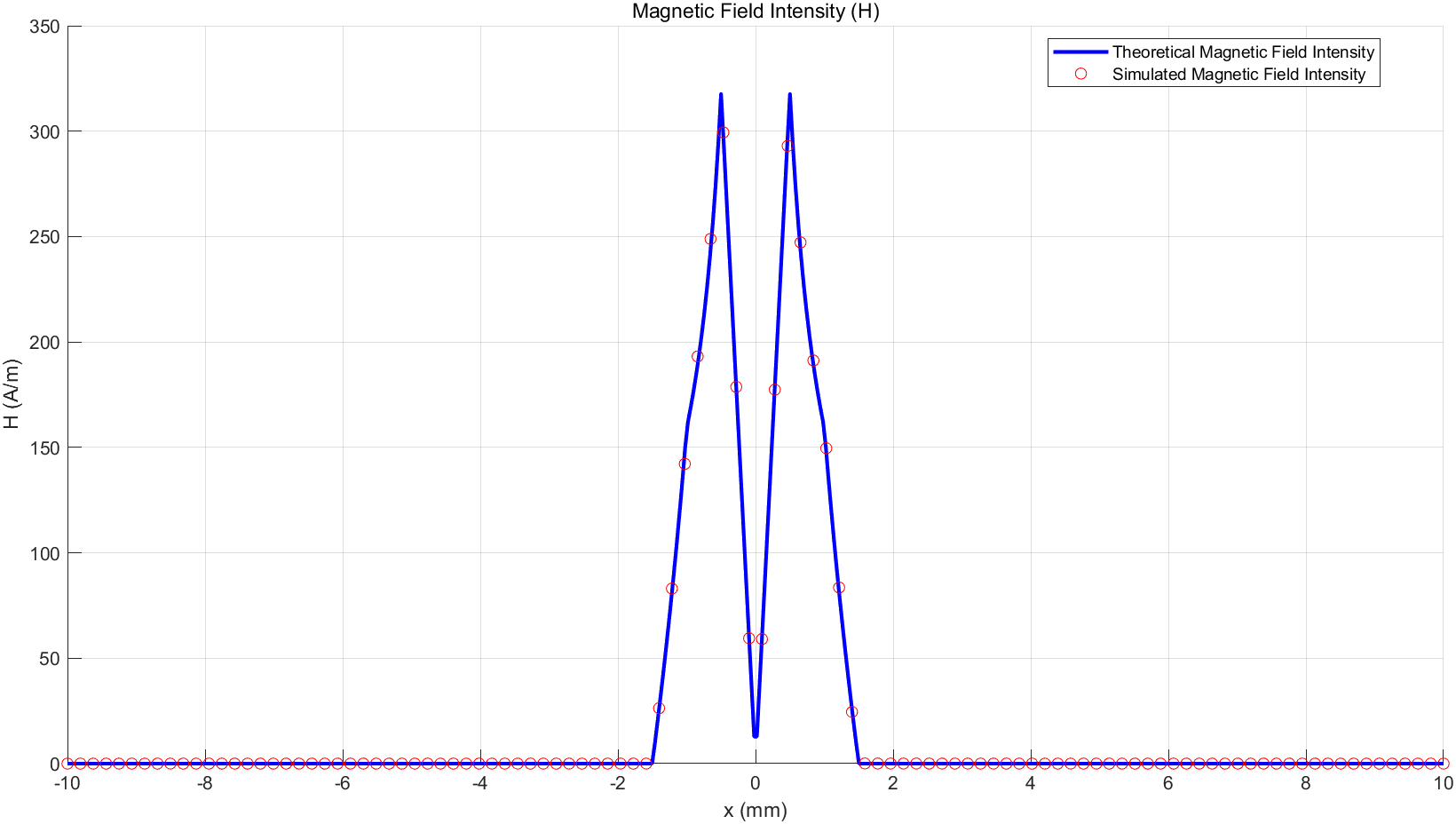


Figure 6 simulation results and theoretical calculation results for H

1. The analysis of simulation results and theoretical calculation results

We first analyze the tendency of the B distribution and H distribution for calculation and simulation value. From the figure, we observe that the B distribution and H distribution are symmetrical so we only analyze the B distribution and the H distribution along positive x axis. When x = 0mm, the B distribution is equal to 0. When 0 < x <=0.5mm, the B distribution is linear increasing. When x = 0.5mm, the B distribution reaches to the maximum. When 0.5 < x < 1mm, the B distribution decreases by inverse proportional function. When 1 < x <1.5mm, the B distribution is linear decreasing. When x >= 1.5mm, the B distribution is equal to 0. Now we analyze the H distribution. When x = 0mm, the H distribution is equal to 0. When 0 < x < 0.5mm, the H distribution decreases by inverse proportional function. When 0.5 <= x < 1.5mm, the H distribution has a tendency to linear decreasing. When x >= 1.5mm, the H distribution is equal to 0.

We observe that the E distribution is basically coincide except around x = 0.5. The maximum of calculation value in x = 0.5mm is larger than the maximum of the simulation value. The difference may causes by the material of the medium. In the experiment, I use the air material to fill the medium. In fact, the attributes of the medium used in the experiment may not the same as the ideal conduct. So in the surface of the medium, it may exists a bit error between simulation value and calculation. Although there exists tiny error, it is acceptable since it is impossible to absolutely simulate the real world condition. From the figure of H distribution, the calculation value and simulation value is basically coincide which indicates that our experiment is reasonable.

1. 理论问题：两个半径都为a的圆柱体，轴间距为d, d<2a，如下图。除两柱重叠部分R外，两柱上各有大小相等、方向相反的电流，密度为**J**,求区域R的**B**。

x-axis direction:



仿真模型：如下图所示，两个圆柱半径为1mm, 轴线与z轴平行，轴线位置分别为x=0.5mm和x=-0.5mm, 除两柱重叠部分R外，两柱上各有大小相等、方向相反的电流1A, 求x轴上[-0.4mm,0.4mm]范围上**B**的大小。

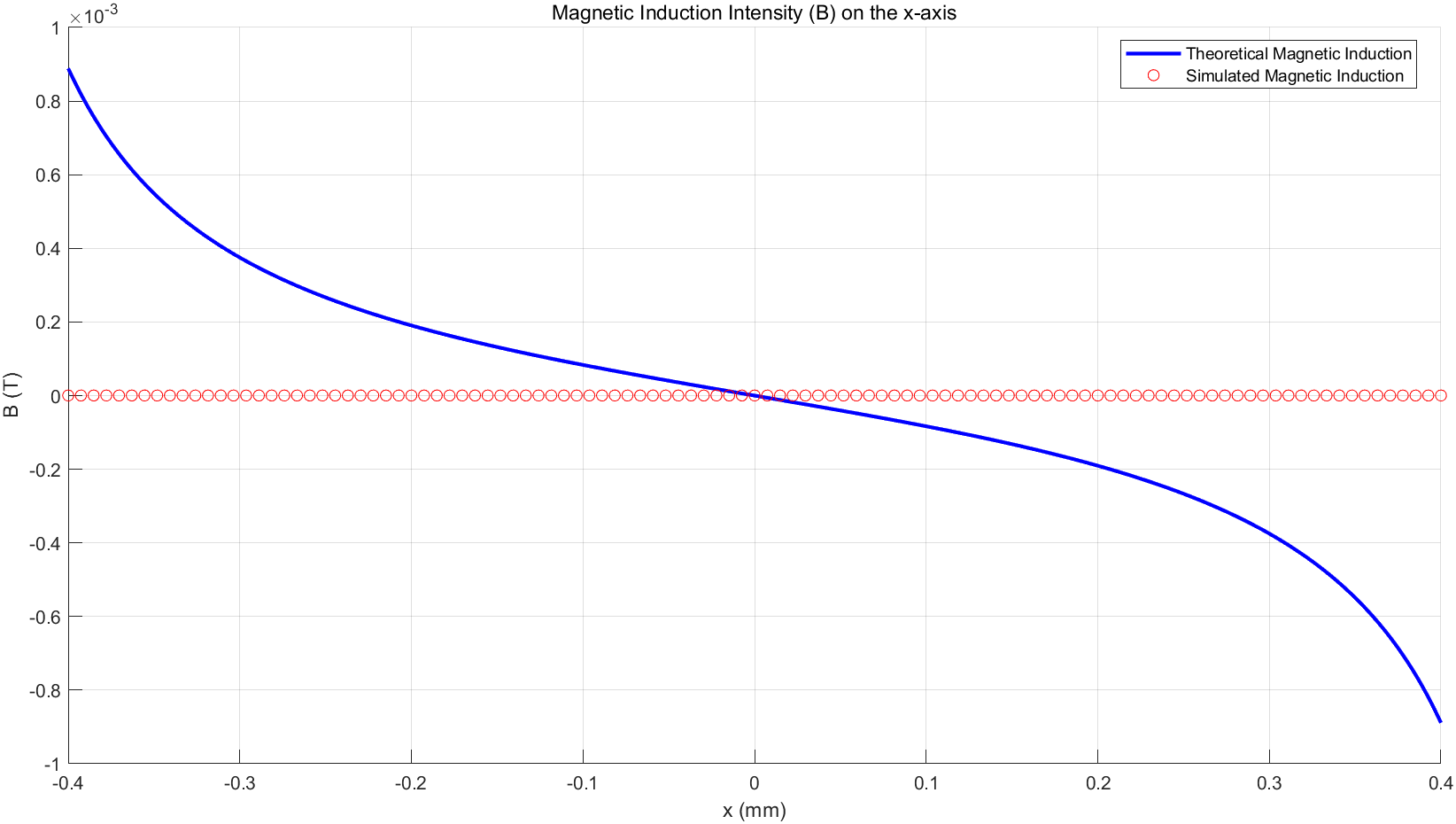
 

Figure 7 simulation results and theoretical calculation results

There are a significant discrepancy between the theoretical and simulated magnetic induction intensity along the axis of a circular current-carrying wire. It trike me to think whether we can’t equilent the stuation to two inflinate long straight wire.