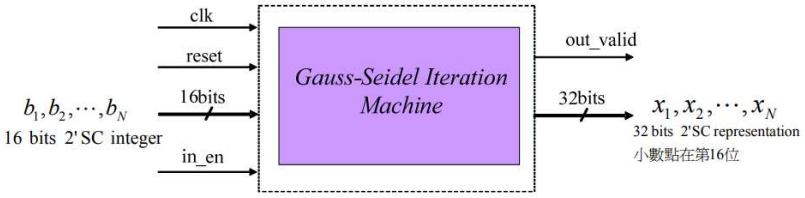
(16) Gauss-Seidel Iteration Machine

甲、摘要

由於反矩陣公式、高斯消去法不適合解大矩陣運算，而且速度慢又不適合作硬體，因此常利用 Gauss-Seidel Iteration Machine 電路來求出多元線性聯立方程式之解 X(如圖一)，其利用疊代法不僅可以計算大型矩陣且非常適合作硬體，而且收斂速度又比 Jacobi Iteration 更快些。

$$AX=B \longrightarrow \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1N} \\ a_{21} & a_{22} & \cdots & a_{2N} \\ \cdots & \cdots & \cdots & \cdots \\ a_{N1} & a_{N2} & \cdots & a_{NN} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ \cdots \\ x_N \end{bmatrix} = \begin{bmatrix} b_1 \\ b_2 \\ \cdots \\ b_N \end{bmatrix}$$

圖一、聯立方程式



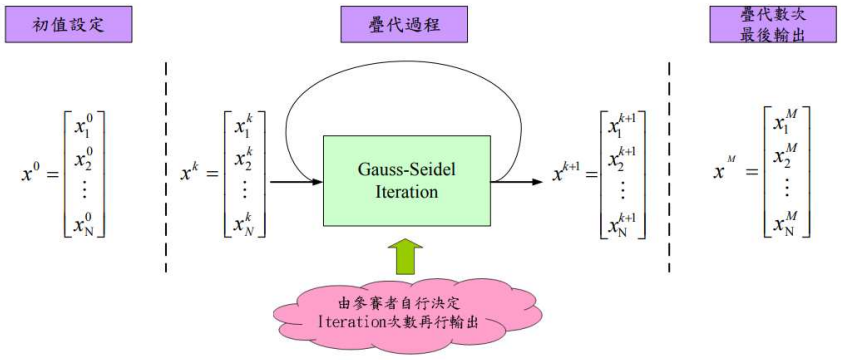

圖二、電路方塊圖

乙、想法

利用 Gauss-Seidel Iteration 公式:

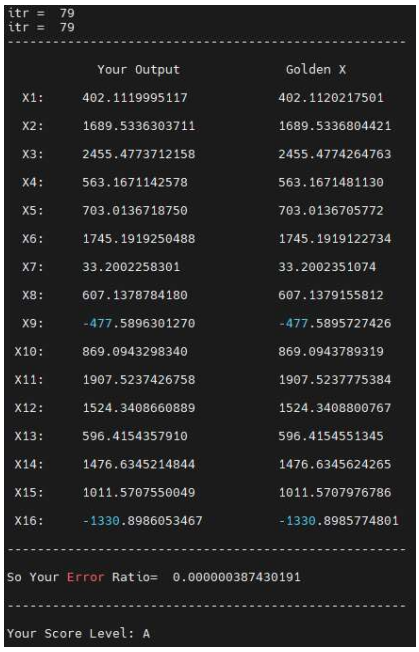
$$x_i^{k+1} = \frac{1}{a_{ii}}\left[b_i - \sum_{j=1}^{i-1} a_{ij}x_j^{k+1} - \sum_{j=i+1}^{N} a_{ij}x_j^{k}\right]$$

並按照疊代流程反覆進行即可得到所求 X。




圖三、Gauss-Seidel Iteration 流程

結果

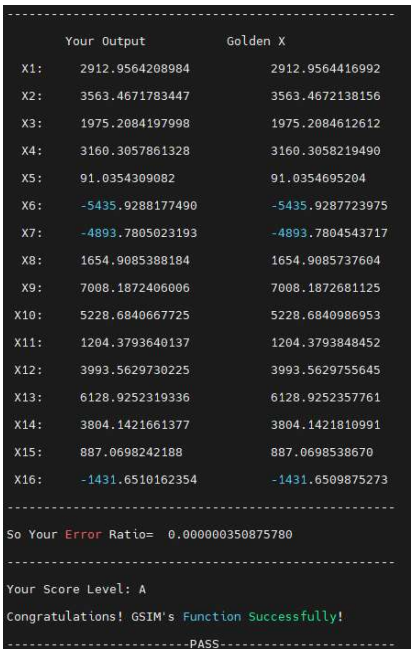


itr = 79
itr = 79

| | Your Output | Golden X |
|---|---|---|
| X1: | 402.1119995117 | 402.1120217501 |
| X2: | 1689.5336303711 | 1689.5336804421 |
| X3: | 2455.4773712158 | 2455.4774264763 |
| X4: | 563.1671142578 | 563.1671481130 |
| X5: | 703.0136718750 | 703.0136705772 |
| X6: | 1745.1919250488 | 1745.1919122734 |
| X7: | 33.2002258301 | 33.2002351074 |
| X8: | 607.1378784180 | 607.1379155812 |
| X9: | -477.5896301270 | -477.5895727426 |
| X10: | 869.0943298340 | 869.0943789319 |
| X11: | 1907.5237426758 | 1907.5237775384 |
| X12: | 1524.3408660889 | 1524.3408800767 |
| X13: | 596.4154357910 | 596.4154551345 |
| X14: | 1476.6345214844 | 1476.6345624265 |
| X15: | 1011.5707550049 | 1011.5707976786 |
| X16: | -1330.8986053467 | -1330.8985774801 |

So Your Error Ratio= 0.000000387430191

Your Score Level: A



| | Your Output | Golden X |
|---|---|---|
| X1: | 2912.9564208984 | 2912.9564416992 |
| X2: | 3563.4671783447 | 3563.4672138156 |
| X3: | 1975.2084197998 | 1975.2084612612 |
| X4: | 3160.3057861328 | 3160.3058219490 |
| X5: | 91.0354309082 | 91.0354695204 |
| X6: | -5435.9288177490 | -5435.9287723975 |
| X7: | -4893.7805023193 | -4893.7804543717 |
| X8: | 1654.9085388184 | 1654.9085737604 |
| X9: | 7008.1872406006 | 7008.1872681125 |
| X10: | 5228.6840667725 | 5228.6840986953 |
| X11: | 1204.3793640137 | 1204.3793848452 |
| X12: | 3993.5629730225 | 3993.5629755645 |
| X13: | 6128.9252319336 | 6128.9252357761 |
| X14: | 3804.1421661377 | 3804.1421810991 |
| X15: | 887.0698242188 | 887.0698538670 |
| X16: | -1431.6510162354 | -1431.6509875273 |

So Your Error Ratio= 0.000000350875780

Your Score Level: A

Congratulations! GSIM's Function Successfully!

PASS

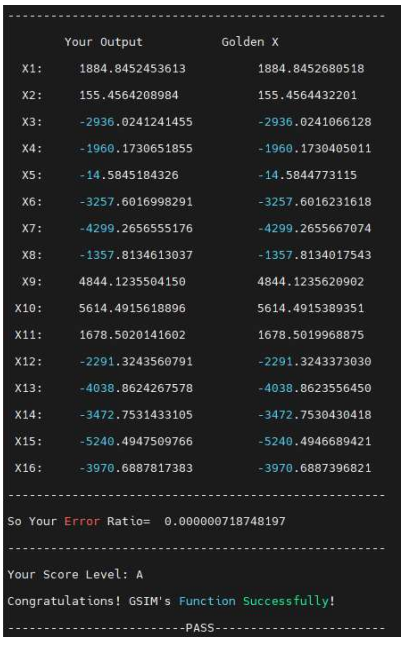
| | Your Output | Golden X |
|---|---|---|
| X1: | -2248.2621307373 | -2248.2621114647 |
| X2: | -5359.6442871094 | -5359.6442373268 |
| X3: | -6168.0845336914 | -6168.0844686399 |
| X4: | -5863.3740234375 | -5863.3739558864 |
| X5: | -5171.6230010986 | -5171.6229404937 |
| X6: | -4936.7632293701 | -4936.7631727776 |
| X7: | -4695.4651947021 | -4695.4651481522 |
| X8: | -2137.3296356201 | -2137.3296006693 |
| X9: | 4742.7447967529 | 4742.7448261517 |
| X10: | 6766.0083312988 | 6766.0083615989 |
| X11: | 2298.8662109375 | 2298.8662460420 |
| X12: | -1152.7576446533 | -1152.7576089337 |
| X13: | -414.8348541260 | -414.8348160071 |
| X14: | 1708.8547515869 | 1708.8547977307 |
| X15: | -737.1266784668 | -737.12663930265 |
| X16: | -2286.5305175781 | -2286.5304956663 |

So Your Error Ratio= 0.000000518979505

Your Score Level: A

Congratulations! GSIM's Function Successfully!

PASS



| | Your Output | Golden X |
|---|---|---|
| X1: | 1884.8452453613 | 1884.8452680518 |
| X2: | 155.4564208984 | 155.4564432201 |
| X3: | -2936.0241241455 | -2936.0241066128 |
| X4: | -1960.1730651855 | -1960.1730405011 |
| X5: | -14.5845184326 | -14.5844773115 |
| X6: | -3257.6016998291 | -3257.6016231618 |
| X7: | -4299.2656555176 | -4299.2655667074 |
| X8: | -1357.8134613037 | -1357.8134017543 |
| X9: | 4844.1235504150 | 4844.1235620902 |
| X10: | 5614.4915618896 | 5614.4915389351 |
| X11: | 1678.5020141602 | 1678.5019968875 |
| X12: | -2291.3243560791 | -2291.3243373030 |
| X13: | -4038.8624267578 | -4038.8623556450 |
| X14: | -3472.7531433105 | -3472.7530430418 |
| X15: | -5240.4947509766 | -5240.4946689421 |
| X16: | -3970.6887817383 | -3970.6887396821 |

So Your Error Ratio= 0.000000718748197

Your Score Level: A

Congratulations! GSIM's Function Successfully!

PASS

圖四五六七、所有測試樣本誤差率皆為 A 等級