

1a)

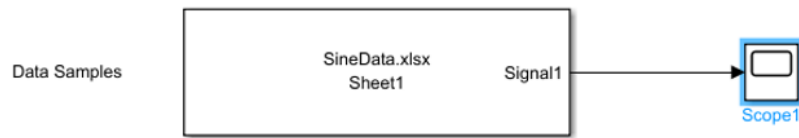


Figure 2: Simulink Block Diagram.

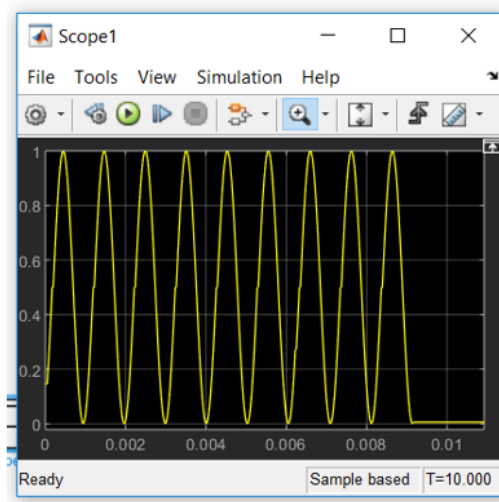
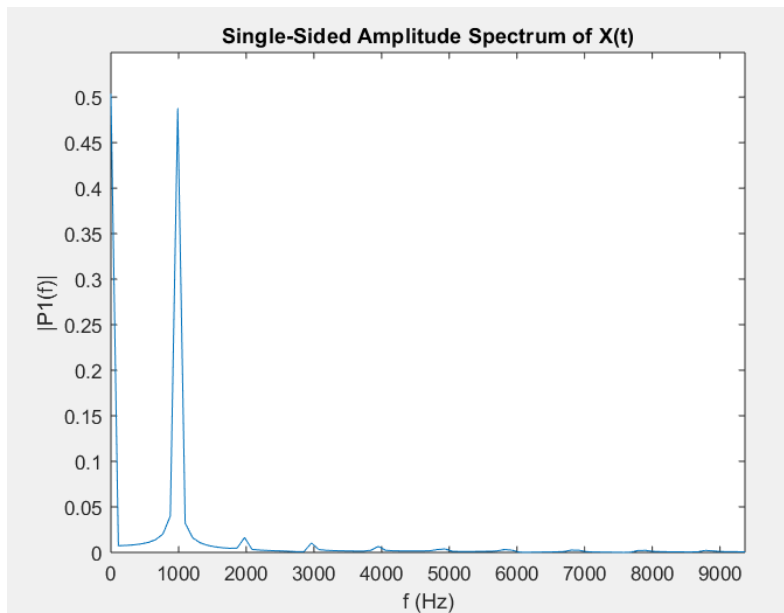


Figure 3: Scope inspection of sine wave.

1b)

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2) The first time through Cppcheck gave an error. After the error was fixed, Cppcheck was again run with no errors.

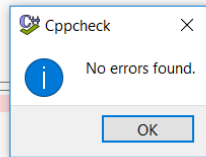
The screenshot shows the Cppcheck application window. The menu bar includes File, Edit, View, Analyze, and Help. Below the menu is a toolbar with various icons. A "Quick Filter:" input field is on the right. The main window displays a list of errors. One error is highlighted: "error" at line 40, with the summary "40 Array 'array[...". Below the error list, a detailed message states: "Array 'array[120]' accessed at index 120, which is out of bounds." At the bottom, the C++ source code is visible. The code defines a sine wave sample and a peak detection algorithm. The error occurs in a for loop where the index 'j' is incremented up to 120, but the array 'array' is only defined with a size of 120, making the access at index 120 out of bounds. The code is as follows:

```
30     sample=0.5+0.5*sin(i*3.14159); // Compute the sine value,+ half the range
31     array[k] = sample;
32 //     pc.printf("\rsample: %f\n", sample);
33     k++;
34     wait(periodTime);
35 }
36
37 // while(1){
38 //     peak detection algorithm
39     for(j=0; j<120; j++){
40         if(array[j] < array[j+1]){
41             ascending = true;
42             maximum = array[j+1];
43         }
44         else if(array[j] > array[j+1] && (ascending == true)){
45             peaks[l] = maximum;
46             timeList[l] = timepast;
47             ascending = false;
48             pc.printf("\rpeak %d: %0.1f\n", c, peaks[l]);
49             c++;
50             l++;
51         }
52         timepast += periodTime;
53     }
54     frequency = 1/(timeList[l] - timeList[0]);
55     pc.printf("\rfrequency: %0.1f\n", frequency);
56     c = 1;
57     fmax = 1/(0.4 - 0.4 + 1);
```

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4) Taking the amount of time it took to go through the program, 0.145843 seconds, and dividing that by the wait time of 1 second gives a processor load of 14.6% in % of CPU cycles.

```
Tera Term - [disconnected] VT
File Edit Setup Control Window Help
The time taken was 0.145844 seconds
peak 1: 1.0
peak 2: 1.0
peak 3: 1.0
frequency: 1004.0
amplitude for peak 1: 0.5
amplitude for peak 2: 0.5
amplitude for peak 3: 0.5
The time taken was 0.145843 seconds
peak 1: 1.0
peak 2: 1.0
peak 3: 1.0
frequency: 1004.0
amplitude for peak 1: 0.5
amplitude for peak 2: 0.5
amplitude for peak 3: 0.5
The time taken was 0.145843 seconds
```