**Lab 1：Introduction**

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| **Introduction**  In this LAB session, the most important task for us is to learn how to use matlab to analysis basic signals, we will use matlab to explore the property of the functions and write a different function in a Discrete-time System.  **NOTE:** To simplify the report **we won’t insert the plot part of our matlab code**.  **Lab results & Analysis**：  **Problem 1.4**  **Task (a):**    **Solution:**  Task 1.4(a)  As shown in the figure, in Figure 1.4(1)-1 is applied to system and Figure 1.4(1)-2 is applied to system  Here we have but we can’t obtain so the system is not linear.  **MATLAB Code:**  n = -5:1:5;  x1=[zeros(1,5) 1 zeros(1,5)];  x2=2\*x1;  y1=sin((pi/2)\*x1);  y2=sin((pi/2)\*x2);  **Task (b):**    **Solution:**  Chart  Description automatically generated  Fig 1.4(b)-1 demonstrate the signal , Fig 1.4(b)-2 demonstrate the signal , Fig 1.4(b)-3 demonstrate the signal output of system .  Because of that the output of the system require the input from the future, so the system is not causal.  **MATLAB Code:**  n1=-5:9;  n2=-6:9;  x1=[zeros(1,5),ones(1,10)];  x2=[zeros(1,4),ones(1,11)];  **Task(c):**    **Solution:**  Chart, histogram, scatter chart  Description automatically generated  For the given interval (0,2), the range of the function is , so the system is not stable.  **MATLAB Code:**  x=0:0.03:2;  y=log(x);  **Task(d):**    **Solution:**  **Chart, line chart  Description automatically generated**  Fig 1.4(d)-1 is the signal , Fig 1.4(d)-2 is the signal , and in Fig 1.4(d)-3 and Fig 1.4(d)-4 we apply and to the system  We found that though but so different input obtain the same output, the system is not invertible.  **MATLAB Code**:  n= -5:1:5;  x1=[zeros(1,5) 1 zeros(1,5)];  x2=5\*[zeros(1,5) 1 zeros(1,5)];  y1=sin((pi/2)\*x1);  y2=sin((pi/2)\*x2);  For each of the following systems, state whether or not the system is **linear, time-invariant, causal, stable,** and **invertible**. For each property you claim the system does not possess, construct a counter-argument using MATLAB to demonstrate how the system violates the property in question.  **Task(e):**  **Solution:**  The system does not satisfy linearity.    In the figure we apply and to the system  We found that though , we cannot obtain here so the system is not linear.  **MATLAB Code:**  % Linearity not satisfied  n=-5:1:5;  x1=n>=0;  x2=3\*x1;  y1=x1.^3;  y2=x2.^3;  **Task(f):**  **Solution:**  Stability, time-invariant and invertibility not satisfied.  Chart, calendar  Description automatically generatedFigure 1.4(f)-1 indicates the output of the system with , Figure 1.4(f)-2 indicates the output of the system with , Figure 1.4(f)-3 indicates the output of the system with , and in Figure 1.4(f)-4, we apply , .  We found that y[n] will grow without bound so the system is not stable, though but we obtain so the system is not invertible, also, we found that so the system does not satisfy time-invariant.  **MATLAB Code:**  % Stability analysis  n=-5:1:5;  x1=n;  y1=n.\*x1;  % invertibility and time-invariant analysis  x2=[zeros(1,5) 1 zeros(1,5)];  x3=3 .\* x2  y2=n .\* x2;  y3=n .\* x3;  y4=(n+1) .\* x2;  **Task(g):**  **Solution:**  The system is not causal, time-invariant, stability.  Diagram  Description automatically generated  Firstly, Figure 1.4(g1)-1 indicates [n+2], Figure 1.4(g1)-2 indicates , then Figure 1.4(g1)-3 indicates , Figure 1.4(g1)-4 indicates , and Figure 1.4(g1)-5 indicates so the system is not time invariant.    Secondly, we found that if as shown in Figure 1.4(g2)-1 and which means the future x is used as input, so the system is not causal.  Chart, box and whisker chart  Description automatically generated  Thirdly, Figure 1.4(g3)-1 indicate the signal , Figure 1.4(g3)-2 indicate the signal , Figure 1.4(g3)-3 indicate the signal , Figure 1.4(g3)-1 indicate the signal , we can found that with different input signal , we will obtain same output, so the system is not invertible.  **MATLAB Code:**  % Time invariant  n=-5:1:5;  x1=n>=-2;  y1=n>=-1;  x2=n>=-4;  y2=n>=-2;  y3=n>=-3;  % Causal  n=-5:1:5;  x1=[zeros(1,7) 1 zeros(1,3)];  y1=[zeros(1,6) 1 zeros(1,4)];  % Invertible  n=-5:1:5;  x1=[zeros(1,4) 1 zeros(1,6)]  y1=[zeros(1,11)]  x2=[zeros(1,2) 1 zeros(1,8)]  y2=[zeros(1,11)]  **Problem 1.5**  **Task(a)**  Text, letter  Description automatically generated    **MATLAB Code:**  function y=diffeqn(a,x,yn1)  y=zeros(length(x));  y(1)=a\*yn1+x(1);  if length(x)>=2  for i=2:length(x)  y(i)=a\*y(i-1)+x(i);  end  end  end  **Task(b)**  Text  Description automatically generated  **Solution:**  Chart  Description automatically generated  In Figure 1.5(b)-1, we apply to the differential function and we get a stable output with , and in Figure 1.5(b)-2, we apply to the differential function and we get the output with .  **MATLAB Code:**  n=0:1:30;  x1=n==0;  x2=n>=0;  a=1;  yn1=0;  y1=diffeqn(a,x1,yn1);  y2=diffeqn(a,x2,yn1);  **Task(c):**  **Text  Description automatically generated**  **Solution:**  **Chart  Description automatically generated**  Figure 1.5(c)-1 indicate the output with input , Figure 1.5(c)-2 indicate the output with input , and Figure 1.5(c)-3 indicates the result of difference , we can found that the difference is always equal to -1, not identically equal to 0, because that here we have in the differential function, so we have and , obviously the system is not linear.  **MATLAB Code:**  n=0:1:30;  x1=n>=0;  x2=2.\*x1;  a=1;  yn1=-1;  y1=diffeqn(a,x1,yn1);  y2=diffeqn(a,x2,yn1);  y3=2.\*y1-y2;  **Task(d):**    **Solution:**  Graphical user interface, chart  Description automatically generated  Figure 1.5(d)-1 indicates the with , and a=0.5, we can found that the y[n] begins at 1 and gradually close to 2, and Figure 1.5(d)-2 indicates the with , and a=0.5, we can found that the y[n] begins at 1.25 and gradually close to 2.  We found that for    We have  So for and the only difference at each item is which will decrease as n increase while |a|<1  **Note**: Please indicate meaning of the symbols in all expressions. Please indicate the coordinate and unit in all figures. | |
| **Experience**  In this LAB session we firstly established the workflow of the computational research for signal and system with matlab, which ensure our efficiency of research, secondly we learnt more operations of matlab which we did not use in the past, and finally we learnt how to analysis the property of a system seriously.  More details could be found [here](https://github.com/Tonanguyxiro/EE205_Signal_and_System_LAB). | |
| **Score** |  |

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