

Modelling and control summaries

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Inverse Laplace 7 – using MATLAB

NUMERICAL TECHNIQUES FOR SOLVING INVERSE LAPLACE USING MATLAB

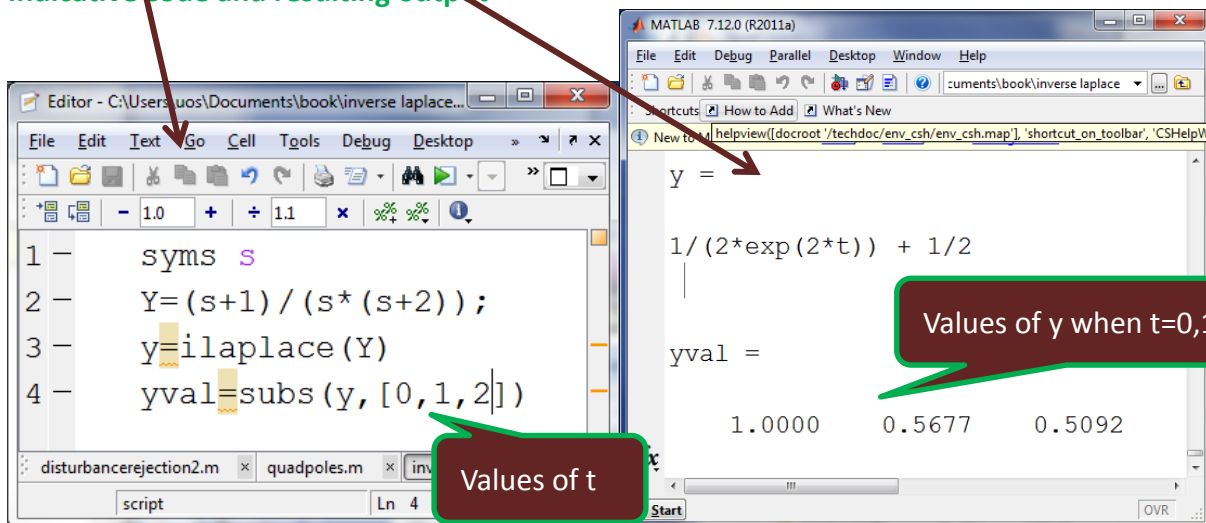
The previous note demonstrated the use of `ilaplace.m` to do an analytical inverse Laplace. In order to find numerical values, the resulting expression is used in the file `subs.m`. **MATLAB also has other tools in the control toolbox which form numerical values directly.**

SYMBOLIC TOOLBOX APPROACHES

1. One can determine the numeric values of the inverse Laplace using `subs.m`
2. `subs` is short for substitute. In other words substitute in the required values of the independent variable.

So the equivalent of $y=f(x)$ in MATLAB code is `y=subs(f,x)` where `f` is the symbolic expression and `x` are numeric values.

Indicative code and resulting output



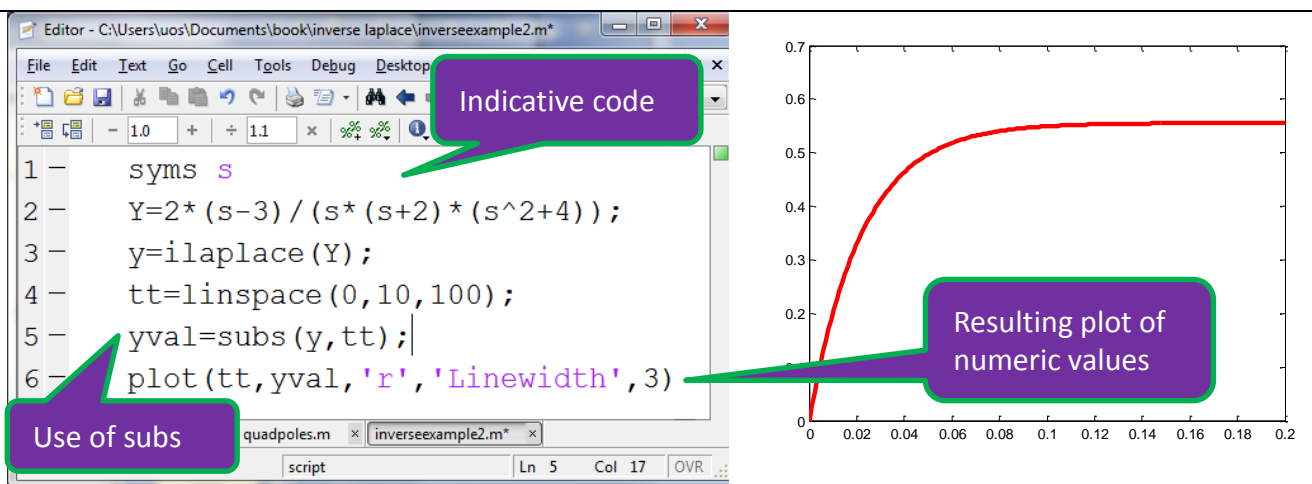
The image shows two MATLAB windows. The left window is the Editor, showing the following code:

```
1 - syms s
2 - Y=(s+1)/(s*(s+2));
3 - y=ilaplace(Y)
4 - yval=subs(y,[0,1,2])
```

The right window is the Command Window, showing the output:

```
y =
1/(2*exp(2*t)) + 1/2
yval =
1.0000 0.5677 0.5092
```

Annotations include a callout box pointing to the `[0,1,2]` in the code with the text "Values of t", and another callout box pointing to the numerical output with the text "Values of y when t=0,1,2".



The image shows the MATLAB Editor with the following code:

```
1 - syms s
2 - Y=2*(s-3)/(s*(s+2)*(s^2+4));
3 - y=ilaplace(Y);
4 - tt=linspace(0,10,100);
5 - yval=subs(y,tt);
6 - plot(tt,yval,'r','Linewidth',3)
```

Annotations include a callout box pointing to the `subs` function with the text "Use of subs", and another callout box pointing to the plot with the text "Resulting plot of numeric values".

The plot shows a red curve representing the numeric values of the inverse Laplace transform. The x-axis ranges from 0 to 0.2, and the y-axis ranges from 0 to 0.7. The curve starts at (0,0) and rises to a value of approximately 0.55 at t=0.2.

CONTROL TOOLBOX:

1. Includes two main files (step.m, impulse.m) for doing inverse Laplace which give the numeric solutions only.
2. Students can get: (i) just a plot or (ii) the numeric values in the workspace.

ASSUMES THE LAPLACE TRANSFORM IS ENTERED USING tf.m

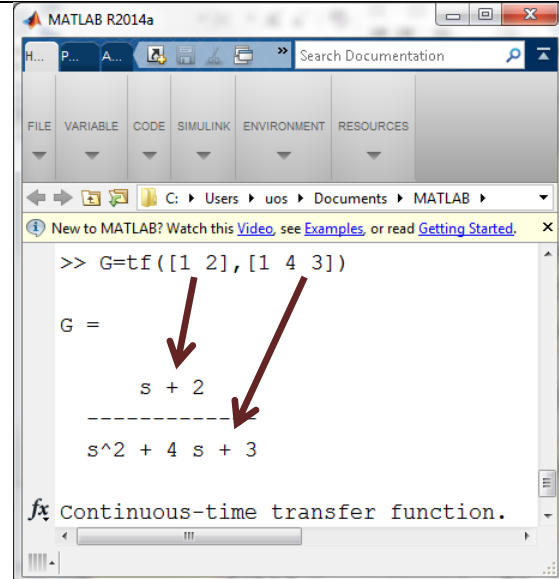
Use of tf.m

- Takes 2 arguments, the numerator coefficients and the denominator coefficients.
- The linkage between the command and the resulting transfer function should be obvious.

Example:

>>G= tf([1 3 4],[2 3 -1 0]) would give

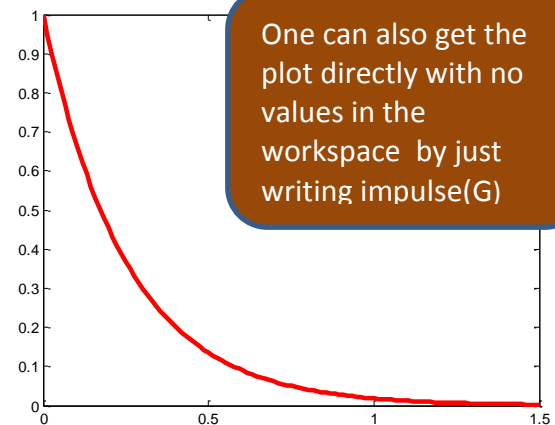
$$G = \frac{s^2 + 3s + 4}{s^3 + 3s^2 - s}$$



impulse.m does the inverse Laplace directly and produces the numeric values and corresponding times – these can then be plotted.

```
1 - Y=tf(1,[1 4])
2 - [y,t]=impulse(Y,1.5);
3 - plot(t,y,'r','Linewidth',3)
```

Use `>>help impulse` to find out more



step.m does the inverse Laplace after first multiplying by a unit step function (1/s) and produces the numeric values and corresponding times – these can then be plotted.

```
1 - G=tf([1 1],[1 5 6])
2 - [y,t]=step(G,3);
3 - plot(t,y,'r','Linewidth',3)
```

Use `>>help step` to find out more

