

# Modelling and control summaries



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## Inverse Laplace 6 – using MATLAB

### ANALYTICAL TECHNIQUES FOR SOLVING INVERSE LAPLACE USING MATLAB

In practice, many problems arise during computer code and we want the solution to be automated; MATLAB can do this for us. MATLAB is also useful for testing our own work and thus getting **feedback** on our progress. This note looks at the built in files `laplace.m` and `ilaplace.m` [part of symbolic toolbox]

### Entering a Laplace transform into MATLAB as a symbolic expression

Make sure you have defined 't' as a symbolic variable for time. [In fact you can use any variable but less confusing if you use 't'.] Then simply write your expression as normal but remember to write the multiply explicitly where required.

```
>> syms t
>> laplace(t)

ans =

1/s^2

fx >>
```

```
>> syms t
>> laplace(exp(-2*t))

ans =

1/(s + 2)

fx >>
```

```
>> laplace(exp(-5*t)*sin(3*t))

ans =

3/((s + 5)^2 + 9)

fx >>
```

### Inverse Laplace uses the function `ilaplace.m` and is equally easy.

```
>> syms s
>> g=1/(s+4)

g =

1/(s + 4)

>> ilaplace(g)

ans =

1/exp(4*t)

fx >>
```

```
f =

3/((s + 5)^2 + 9)

>> ilaplace(f)

ans =

sin(3*t)/exp(5*t)

fx >>
```

The main caviat is the answer is not always in the format you would most like. Note here how the exponentials are written in the denominator!

```

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>> q=(s^2+3*s-1)/(s*(s^2+5*s+6))

q =

(s^2 + 3*s - 1)/(s*(s^2 + 5*s + 6))

>> ilaplace(q)

ans =

3/(2*exp(2*t)) - 1/(3*exp(3*t)) - 1/6

fx
Start OVR

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>> syms s
>> U=1/s;
>> G=3/((s+1)*(s+2));
>> Y=G*U;
>> ilaplace(Y)

ans =

3/(2*exp(2*t)) - 3/exp(t) + 3/2

fx >>
Start OVR

```

### Evaluating the result:

As the answer is a symbolic expression, it can be evaluating using subs.m

```

MATLAB R2014a
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>> syms s
>> G=(6/(4*s+2))*(0.9/(s^2+0.81))

G =

27/(5*(4*s + 2)*(s^2 + 81/100))

>> gt=ilaplace(G)

gt =

(135*exp(-t/2))/106 - (135*cos((9*t)/10))/106 + (75*sin((9*t)/10))/106

>> gvalues=subs(gt,2)

gvalues =

(135*exp(-1))/106 - (135*cos(9/5))/106 + (75*sin(9/5))/106

fx
Start OVR

```

Define transform directly, not via the original time domain signal.

Evaluate g(t) at t=2. (You can do several values of t at once)