PREMIER UNIVERSITY

Department of Computer Science & Engineering

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Course Title	:	**Signals & Systems Laboratory**
Report No	:	**07**
Name of Report	:	**Implementing Laplace transform & Inverse Laplace Transformation in MATLAB**
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Section	**: C**
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REMARKS

Experiment no: 07

Experiment name: Implementing Laplace transform & Inverse Laplace Transformation in MATLAB

Objective: To implement Laplace transform & Inverse Laplace Transformation in MATLAB.

Software Requirement: MATLAB 2014

Theory:

Laplace transform

The Laplace transform is defined as follows:

$$F(s) = c\int_0^\infty f(t)e^\wedge - st\,dt$$

Syntax

laplace(f,trans_var,eval_point)

Description

laplace(f,trans_var,eval_point) - computes the Laplace transform off with respect to the transformation variable trans_var at the point eval_point.

Input Arguments

f- Symbolic expression, symbolic function, or vector or matrix of symbolic expressions or functions.

trans_var- Symbolic variable representing the transformation variable. This variable is often called the "time variable".

Default: The variable t. If f does not contain t, then the default variable is determined by symvar.

eval_point- Symbolic variable or expression representing the evaluation point. This variable is often called the "complex frequency variable".

Default: The variable s. If s is the transformation variable of f, then the default evaluation point is the variable z.

Examples

Compute the Laplace transform of this expression with respect to the variable x at the evaluation point y:

CODE:-1 , f=2t;

```
>> syms s t;
>> f=2*t;
>> laplace(f)
 ans =
 2/s^2
```

```
>> pretty(ans)
 2
--
 2
s
>> y=2/s^2;
>> ilaplace(y)
ans =
2*t
```

CODE:-2 , f=t^2;

```
>> f=t^2;
>> laplace(f)
ans =
2/s^3
>> pretty(ans)
 2
--
 3
s
>> a=2/s^3;
>> ilaplace(a)
ans =
t^2
```

CODE:-1 , f=2t;

```
>> f=exp(2*t);
>> laplace(f)
 ans =
 1/(s - 2)
 >> pretty(ans)
  1
-----
s - 2
>> ilaplace(ans)
ans =
exp(2*t)
```

CODE:-4 , f=2t+3t^2+2e^{2t};

```
>> f = 2*t + 2*exp(2*t) + 3*t^2;
>> laplace(f)
 ans =
2/(s - 2) + 2/s^2 + 6/s^3
>> pretty(ans)
  2     2   6
```

```
----- + -- + --
s - 2    2    3
       s    s
>> ilaplace(ans)
ans =
2*t + 2*exp(2*t) + 3*t^2
```

Lab Tasks:

Find out the laplace transform of the following functions:

i. e^{-at}

```
>> syms s t a;
>> laplace(exp(-a*t))
ans = 1/(a + s)
>> pretty(ans)
  1
-----
a + s
>> syms s t a w;
>> laplace(exp(-a*t) * sin(w*t))
ans =
w/((a + s)^2 + w^2)
>> pretty(ans)
      w
-------------
       2    2
(a + s)  + w
>> ilaplace(ans)
ans =

exp(-a*t)*sin(t*w)
```

ii. e^{-at} **sin ωt**

```
>> syms s t a w;
>> laplace(exp(-a*t) * sin(w*t))
ans =
w/((a + s)^2 + w^2)

>> pretty(ans)
      w
-------------
       2    2
(a + s)  + w

>> ilaplace(ans)
ans =
 exp(-a*t)*sin(t*w)
```

iii. **cos ωt**

```
>> syms s t w;
```

```
>> laplace(cos(w*t))
ans =
s/(s^2 + w^2)
>> pretty(ans)
   s
-------
 2    2
s  + w
>> ilaplace(ans)
ans = cos(t*w)
```

iv. sin ωt

```
>> syms s t w;
>> laplace(sin(w*t))
ans =
w/(s^2 + w^2)
>> pretty(ans)
   w
-------
 2    2
s  + w
>> ilaplace(ans)
ans =

sin(t*w)
```

Discussion :

In this lab experiment, we explored the application of Laplace transformations in the analysis of linear time-invariant systems. The Laplace transform is a powerful mathematical tool commonly used in engineering and applied mathematics to simplify and solve differential equations. By transforming a time-domain function into the frequency domain, Laplace transforms provide a convenient method for analyzing and understanding complex systems.