

SOFIA LAPLACE AND INVERSE LAPLACE TRANSFORM PACKAGE

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Reference: **Christomir Kazasov**, Laplace Transformations in REDUCE 3, Proc. Eurocal '87, Lecture Notes in Comp. Sci., Springer-Verlag (1987) 132-133.

Some hints on how to use to use this package:

Syntax:

LAPLACE(*< exp >*, *< var - s >*, *< var - t >*)

INVLAP(*< exp >*, *< var - s >*, *< var - t >*)

where *< exp >* is the expression to be transformed, *< var - s >* is the source variable (in most cases *< exp >* depends explicitly of this variable) and *< var - t >* is the target variable. If *< var - t >* is omitted, the package uses an internal variable lp!& or ill!&, respectively.

The following switches can be used to control the transformations:

- lmon: If on, sin, cos, sinh and cosh are converted by LAPLACE into exponentials,
- lhyp: If on, expressions $e^{\tilde{x}}$ are converted by INVLAP into hyperbolic functions sinh and cosh,
- ltrig: If on, expressions $e^{\tilde{x}}$ are converted by INVLAP into trigonometric functions sin and cos.

The system can be extended by adding Laplace transformation rules for single functions by rules or rule sets. In such a rule the source variable MUST be free, the target variable MUST be ill!& for LAPLACE and lp!& for INVLAP and the third parameter should be omitted. Also rules for transforming derivatives are entered in such a form.

Examples:

```
let {laplace(log(~{ }x),x) => -log(gam { } il!&)/il!&,
invlap(log(gam { } ~{ }x)/x,x) => -log(lp!&)};

operator f;

let{
laplace(df(f(~{ }x),x),x) => il!&{*}laplace(f(x),x) - sub(x=0,f(x)),
laplace(df(f(~{ }x),x,~{ }n),x) => il!&{*}{*}n{*}laplace(f(x),x) -
for i:=n-1 step -1 until 0 sum
sub(x=0, df(f(x),x,n-1-i)) { } il!&{*}{*}i
when fixp n,
laplace(f(~{ }x),x) = f(il!&)
};
```

Remarks about some functions:

The DELTA and GAMMA functions are known.

ONE is the name of the unit step function.

INTL is a parametrized integral function

$$\text{intl}(\langle expr \rangle, \langle var \rangle, 0, \langle obj.var \rangle)$$

which means "Integral of $\langle expr \rangle$ wrt. $\langle var \rangle$ taken from 0 to $\langle obj.var \rangle$ ",
e.g. $\text{intl}(2*y^2, y, 0, x)$ which is formally a function in x .

We recommend reading the file LAPLACE.TST for a further introduction.