Laplace transform

Laplace transforms turn time-domain functions, where \$t\$ is the variable (time), into frequency-domain functions, where \$s\$ is the variable (complex frequency).

Formal definition

 $F(s) = \inf_{0}^{t} t_{0} dt$

Inverse Laplace transform

Similar to the Z-transform, we usually calculate the inverse Laplace transform by reorganizing the Laplace representation into a form we recognize with partial fractions and then pattern matching. Again, the time-domain representation depends on the desired region of convergence - the same Laplace domain representation can result in different time-domain representations, depending on the RoC.

Laplace domain representation	Region of convergence	Time-domain representation
$H(s)=\int \{1\} \{s-p\}$	\$s > p\$	$h(t)=e^{t}u(t)$
$H(s)=\int \{s-p\}$	\$s < p\$	$h(t)=-e^{t}u(-t)$
H(s) = 1	All	h(t) = delta(t)

Why Laplace transforms are cool

Integration in the time domain becomes division by \$s\$ in the Laplace domain, and differentiation in the time domain becomes multiplication by \$s\$ in the Laplace domain. This is useful for block diagrams.

References

https://mathvault.ca/laplace-transform/

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