

Lecture S14 Muddiest Points

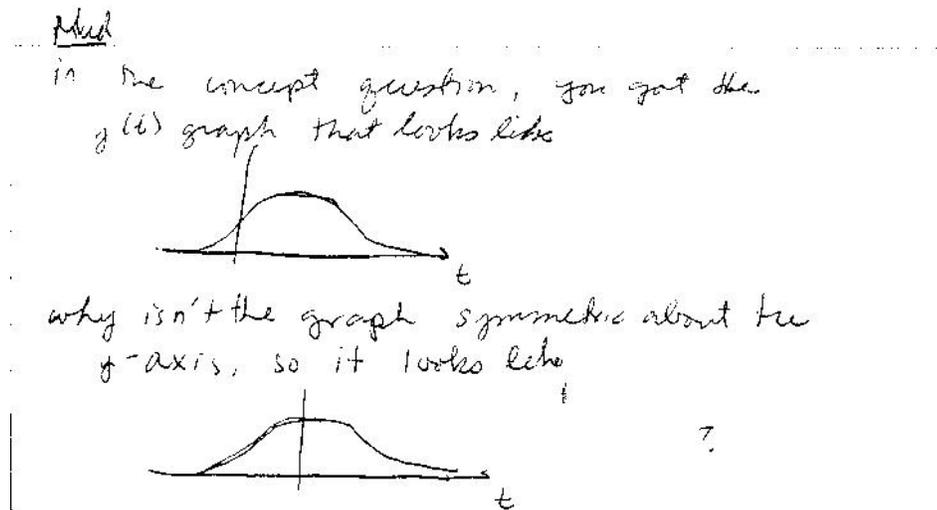
General Comments

In today's lecture, we looked at the problem of finding the inverse LT for bilateral Laplace transforms. Although noncausal systems are rare, they do occur, so the bilateral LT is important.

Responses to Muddiest-Part-of-the-Lecture Cards

(11 cards)

1. *In the concept question, you got the $y(t)$ graph that looks like [1st graph]. Why isn't the graph symmetric about the y axis, so it looks like [2nd graph]?*



- (1 student) $g(t)$ is symmetric about $t = 0$, but $u(t)$ isn't. As a result, $y(t)$ isn't symmetric.
2. *If $G(s)$ has three terms, how do we know the region of convergence? (1)* The r.o.c. depends on information other than the number of terms in the partial fraction expansion of $G(s)$. For example, if we know that the signal $g(t)$ is causal, then we know that the r.o.c. is to the right of the rightmost pole. If we know $g(t)$ is stable, then the r.o.c. includes the imaginary axis. There are other ways to determine the r.o.c., depending on the problem.
 3. *So whenever something is converging to the left ($s < a$), you flip the sign of $\sigma(t)$? (1)* Basically, yes. When the r.o.c. is a left half plane, generally the resulting $g(t)$ (or portion of $g(t)$) will be an exponential times $\sigma(-t)$. The sign of the exponential will also be different from the result when the r.o.c. is to the right. We do have to be careful, though, when $G(s)$ is not a rational function. For example, if

$$G(s) = \frac{e^{-s}}{s-1}, \quad s < 1$$

then the inverse transform is

$$g(t) = -e^{t-1}\sigma(1-t)$$

because e^{-s} is the LT of a unit (one second) delay.

4. *If you were using the smoother on real data, would it make any sense to keep the part for less than zero if there was no signal there in the first place? (1)* If you knew for a fact that the measurement $[u(t)]$ should be zero for $t < 0$, then you are right, it wouldn't necessarily make sense to use a smoother in the vicinity of $t = 0$. However, if you used a different average near $t = 0$ than you use for t much greater than zero, then the system won't be time-invariant, and we can't use Laplace methods.

5. *Will we ever integrate that formula*

$$g(t) = \frac{1}{2\pi j} \int_{c-j\infty}^{c+j\infty} G(s)e^{st} ds$$

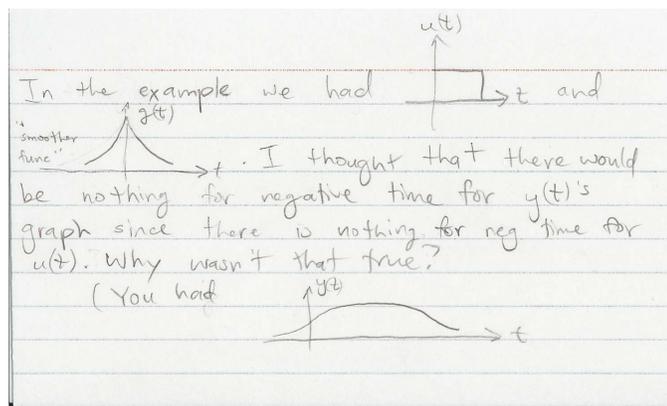
Also, if the r.o.c. is a strip, shouldn't the inverse LT be a double integral over the whole r.o.c.? (1) I don't expect you to be able to do the inverse LT integral, because it requires 18.075 or equivalent to do the integral. (I do expect you to be able to find inverse LTs by other methods, though.) The inverse LT should *not* be a double integral. The point here is that the integral doesn't depend on c , so long as c is in the r.o.c.

6. *In the example*

$$G(s) = \frac{s+2}{(s+1)(s+3)}$$

Why is the r.o.c. $s < -1$? (1) In the example, I *assumed* that that was the r.o.c. In other problems, you may have to deduce the r.o.c. from other information.

7. *In the PRS question, we had [graph for $u(t)$] and [graph for $g(t)$]. I thought that there would be nothing for negative time for the $y(t)$ graph, since there is nothing for neg time for $u(t)$. Why wasn't that true? (1)*



Because $g(t)$ is noncausal! In general, the earliest time that $y(t)$ is nonzero is the earliest time that $u(t)$ is nonzero *plus* the earliest time that $g(t)$ is nonzero.

8. *Why did you have the extra negative in front for the inverse LT of*

$$\frac{-1/2}{s-a}, \quad s < a$$

but not for the inverse LT of

$$\frac{-1/2}{s+a}, \quad s > -a$$

(1) Whenever the r.o.c. is for a left half plane (as in the first case), the inverse LT gets an extra negative sign in front.

9. *No mud. (3) Comments: Why is grading for Unified so unorthodox? I.e., no published averages, Joe B., etc.* We grade against a standard, the MIT definition of grades. It's possible for everyone in the class to get an "A", or for everyone to get an "F". Therefore, the average doesn't mean anything to you as an individual — your grade does not depend on the average. The piece of information you need is what grade you got, and that's what Joe B. is for. Why do we do things that way? (1) MIT rules require grading against a standard, not on a curve. (2) It's the right thing to do.