# Re: Standing−Wave Current vs Traveling−Wave Current

***Source:*** http://newsgroups.derkeiler.com/Archive/Rec/rec.radio.amateur.antenna/2007−12/msg01846.html


- *From*: Roy Lewallen <w7el@xxxxxxxxx>
- *Date*: Sat, 29 Dec 2007 09:49:54 −0800


Roger wrote:

> Roy Lewallen wrote:
>
> > . . .
> > at any point x, in degrees, along the line. This is also the total voltage since there's no reflection yet.
>
> "x" is referenced from the leading edge of the wave. At time 2pi, a complete rotation has occurred and the wave front traveled to the open circuit point. Understood.

No. x is referenced to the input end of the line. This is very important. I'm sorry my statement that it is "any point x, in degrees, along the line" didn't make this clear.

> As your argument is developed below, you begin using positive x. What is the zero point it is referenced to? I will assume that it is leading edge of original reference wave.

No, it's the input end of the line.

> Sin(+x) represents a different polarity from the −x reference we were using prior to this. I will remember this as I move through the argument.

Sorry, but I don't understand this statement.

> You begin the following argument using a reflection coefficient of −1, which reverses the polarity of the wave. Am I to understand that your model treats the input as a short circuit for the reflected wave? Maybe I am missing an important point.

Yes, that is correct. The impedance of the source (a perfect voltage source) is zero, so the reflection coefficient seen by the reverse traveling wave is −1.

> In my model, the source voltage must change when the returning wave hits the input end.

Then we've been using a different model. The one I've been using is the one proposed by "Dave" −− a half wavelength open circuited line driven by a voltage source −− except with your change in line length to one wavelength. You cannot cause the voltage of a perfect voltage source to change.

>> Let's follow the returning wave as it hits the input end and re−reflects. The reflection coefficient at the source is −1 due to the zero−impedance ideal voltage source, so the re−reflected wave is
>>
>> $vf2(t, x) = -\sin(wt - x)$

> Earlier, we defined the forward wave as $vf(t, x) = \sin(wt - x)$, so it is logical to define $vf2(t, x) = \sin(wt - x)$. I do not see the logic in reversing the voltage polarity with the minus sign.

The original forward wave is $\sin(wt - x)$. The reflected wave is $\sin(wt + x)$, where the change in sign of x is a consequence of the reversal of direction. Reflection from the source causes an inversion of the wave polarity because of the −1 reflection coefficient, and another sign change of x due to the reversal of direction, resulting in the equation above.

>> and the total voltage anywhere along the transmission line just before the re−reflection reaches the far end is $vf(t, x) + vr(t, x) + vf2(t, x) = \sin(wt - x) + \sin(wt + x) - \sin(wt - x) = \sin(wt + x)$. Now this is interesting. When the second forward wave vf2 is added into the total, the standing wave disappears and the total voltage is just a plain sine wave with peak amplitude of 1. It's identical, in fact, to the original forward voltage wave except reversed in phase.

> Wow! This would happen if the re−reflection actually reverses. How could this occur if we consider that voltage is a collection of positive or negative particles?

Well, if it couldn't, then your concept of voltage is flawed. You might re−think it.

> We would have a positive reflection meeting with a positive outgoing wave (or negative meeting negative). The situation would be the same as at the open circuit end immediately following initial reversal, or current would simply stop flowing from the source.

In fact, current does quit flowing from the source. The line is fully charged and there is no load to dissipate any further energy from the source. Any analysis showing continued current from the source is obviously wrong for that reason.

> I think you would agree that a steady state standing wave would form immediately upon reflected wave reaching the initiating source if the wave did not reverse.

I'm sorry, I don't understand that question.

> I admire the time and effort spent on this analysis Roy. Very well done no matter how history judges the merits of the argument. I think I followed it all, and understood.

As I've mentioned, there are other valid ways of analyzing such a circuit. At the end of the day, any analysis must produce the correct result. Getting the correct result doesn't prove that the analysis is valid, but failure to get the correct result proves that an analysis is invalid. SPICE uses fundamental rules for analysis, so is a good authority of what the answer should be, and it shows that my analysis has produced the correct result.

> The gif's certainly made it clear why you are skeptical of the power of traveling wave analysis.

The SPICE results are simply a way of verifying that my analysis is correct. The concept of traveling waves of average power has other, serious problems.

> Could we further discuss the merits of reversing the wave polarity when the reflected wave returns to the source?

Sure. First please review the concept of reflection coefficient.

The behavior of the returning waves when they reach the source is often not included in transmission line analysis because it plays no part in determining the steady state SWR, impedance, or relationship between voltages and currents at the ends or anywhere else along the line. The only thing it impacts is the way steady state is reached during turn−on, and not the final steady state condition itself, and this isn't generally of interest. (An exception is the contrived and actually impossible case of a completely lossless system such as the one I analyzed, and it's not an exception either if viewed as a limiting case.) As I mentioned in my posting, the steady state result is exactly the same for any non−zero source resistance; the only effect of the resistance is in determining how steady state is reached.

Roy Lewallen, W7EL
.