THEORY

The theory behind **Sunny Cable Technology's "Time Accurate Cables"** is our ingenious application of proven electromagnetic theories and our understanding of conductor material behavior during signal transmission through cables.

What Exactly Are Signals In Home Theater And Audio?

Signals are basically electrical energy (voltage and current) modulated in relation to time.

Analog Signals:

Analog audio signals (in the audible sound spectrum) are signals having a fundamental frequency range of 20 Hz to 20,000 Hz. The frequency spectrum and the amplitude of the signals are infinitely varied on a continuous basis in accordance with the music or program material. And the distinction between the signals carried by interconnects (signal cables) and those inside the loudspeaker cables should only be amplitude, in terms of current and voltage, but not timing or sequence.

In other words, the exact signal strength (voltage swing and current flow) carried by the cables is not at all important because signals can be attenuated (by means of volume control) or amplified during the different stages of sound reproduction.

Analog video signals transmission can be explained in pretty much the same manner.

Digital Signals:

Digital signals work on a binary system of "on's" (or "ones", essentially high frequency pulses) and "off's" (or "zeros", meaning no-pulse), such that both the pulses and the zeros are part of the signals themselves. As all digital signals are of high frequency, the rise-time (the time it takes for the instantaneous change in current from pulse to no-pulse, or vise versa) between a "one" and a "zero" is extremely small.

AC Power:

AC power transmission (household electricity) can be analyzed as a form of electrical signal transmission. Although different countries have different electrical transmission systems, yet the voltage (either 100-120 v or 200-250 v) and frequency (50 Hz or 60 Hz) are always kept constant. The only changes are the amount of electrical current transmitted through the conductor inside a cable at any particular moment, in response to the requirement of the equipment in use at that time.

What Is Accurate Signal Transmission?

Accurate signal transmission for analog signals means the accuracy in preserving the exact variations in both voltage and current as they are transmitted with respect to time.

For digital signals, accurate signal transmission means the accuracy in preserving the stream of pulses and no-pulses as they are transmitted, also with respect to time.

For AC power, accurate transmission means the accuracy in providing the exact instantaneous change in current requirements as called for by the equipment in use, again, with respect to time.

Is This Infinitesimal Difference In Time Really Critical?

Some people argue that since electricity travels almost at the speed of light, any infinitesimal differences in time could not be of any significance in signal accuracy. Theoretically, they might have a point. However, since electricity requires a conductor for transmission, and all conductor materials have limitations by their inherent physical properties and cannot perform at the theoretical maximum ability, the difference in timing accuracy is no longer negligible but very noticeable.

How Is Signal Accuracy Affected?

Accuracy in signal transmission is affected by the harmful effects of the following: (1) multiple-conductor pathway error, (2) self-inductance, (3) mutual inductance, (4) stored energy released by capacitors, (5) vibration and mechanical resonance, and (6) external electromagnetic interference (EMI).

(1) Multiple-Conductor Pathway Error:

When a signal is transmitted through a cable with multi-stranded conductor wires, the number of possible pathways for different frequency components of a signal to follow can be astronomical. And it is not up to us to control which frequency component of a signal shall follow which strand. Signals will travel "the path of least resistance", whichever that might be.

The result of signals traveling in literally millions of different pathways (each time a strand of bare conductor touches another strand, it is a possible pathway) is the increased likelihood that different frequency components of a signal will arrive at the output end of the cable at slightly different times, resulting in *time-smear* (explained below).

(2) Self-Inductance:

In physics we learn that whenever an electric current passes through a conductor, a magnetic field in the direction radiating out from the conductor will be generated at the same time. This magnetic field will induce an eddy current in the conductor by the physical phenomenon called s*elf-inductance*, and it causes time-related distortions such as (a) *group delay* and (b) *damping* and *time-smear*.

(a) Group Delay:

Since audio and video signals are electric currents (albeit very weak ones) passing through a conductor (cable), they are all subject to the influence of s*elf-inductance*. Unfortunately, different frequency components of the signal will be affected differently by the induced eddy current, resulting in the low, mid-range, and high frequency components of the signal arriving at the output end of the cable at slightly different times. This time-related distortion is called *group delay*; and analog signals are most susceptible to this distortion and the resulting inaccuracy.

Different conductor materials such as copper and silver have distinct inherent *group delay* characteristics. This accounts for a majority of the differences in performance of conductor materials.

(b) Damping And Time-Smear:

The induced local eddy currents caused by *self-inductance* also act as a *damping* force to oppose any changes in amplitude and polarity of the signal. This *damping* effect causes different problems for different kinds of signals.

For AC power supply, which has a fixed voltage and frequency, *damping* results in the restriction of instantaneous current flow to the equipment drawing the power. This restriction would not be a problem for equipment that draws a constant amount of current (e.g. fans, heaters, etc.) On the other hand, equipment that draws a varied current demand over time, such as a transistor amplifier, would not receive the correct amount of current it needs at any given time for peak performance when *damping* occurs.

For both analog and digital signals, *damping* delays signal rise-time for different signals resulting in another time-related distortion called *time-smear*. The impact of *damping* is especially greater for digital signals as the difference in rise-time between a pulse and a zero is extremely small.

(3) Mutual Inductance:

Mutual inductance is the phenomenon when a current is induced in a conductor as a result of the influence of the magnetic field from another conductor nearby.

The induced eddy current will affect signal transmission accuracy much the same way as the eddy currents from *self-inductance*.

(4) Stored Energy Released by Capacitors:

A capacitor is formed whenever two conductors are separated by a non-conducting material (called dielectric in general). A capacitor will store electrical energy and will release it upon accumulation or when the polarity of the capacitor is reversed. Needless to say, this storing and releasing of electrical energy will have major influence on signal transmission.

(5) Vibration And Mechanical Resonance:

A conductor will vibrate when it is carrying a current. A conductor will also vibrate when it is "hit" by sound waves. This vibrating will reach its peak when the frequency of the vibration is equal to the mechanical resonance frequency of the cable. Vibrations will cause shifting of the magnetic fields of the conductor and this, in turn, will be another source of time-related distortion.

(6) External Electromagnetic Interference:

It should not be difficult to understand that if the conductors in a cable are not properly shielded from external electromagnetic interference (EMI, which is present almost everywhere in our living environment), signal accuracy will be affected.

Proven Concepts in Physics

While I offered no formulas to calculate the exact time-distortion from the phenomena I described above, they are all accepted and proven concepts in the field of physics.

What Are "Time Accurate Cables"?

From the above discussion, we now have some idea how time-related distortions affect accuracy in signal transmission through cables. I should point out that these physical phenomena that produces time-distortions affect every cable (including ours) on the market. Other cable designers either ignore the problem or they have not found a way to effectively deal with time-distortions.

Without revealing the secrets of our Patent Pending design, let's just say that we have invented an ingenious way to solve the above discussed problems.

Essentially, we use only one solid-core conductor for each pole of the cable to avoid multiple-conductor pathway errors. Which material and diameter conductor to use depends on the application of the cable. We then configure the conductors in ways that minimize self-inductance. We also have means to minimize capacitance, vibration and mechanical resonance. Finally, we provide our cables with adequate shielding from EMI.

The end product of this revolutionary design are cables so accurate in the reproduction of audio/video signals, we called them **"Time Accurate Cables"**!

No Gimmicks, No Filters, No Processors, No Compromises

It is important for you to know that we use *no gimmicks, no filters, no processors, and no compromises* in the design and manufacturing of our **"Time Accurate Cables"**. Why? Simply because employing these things and strategies might solve one problem but eventually they lead to other problems. We only apply scientifically proven theories and our knowledge of the inherent physical properties of different materials in the making of our cables. The process is delicate, time-consuming, and all hand-made. Our **"Time Accurate Cables"** may not be fancy looking, but they do perform beautifully!

What Is The Bottom Line!

That's right. Enough talk about theories. In fact, even the best theories in the world mean nothing if we cannot put them into practice. Fortunately, it *worked!* In fact, it works even better than I had anticipated.

When I started this research in 1997, I was only interested in producing better sounding interconnects and loudspeaker cables. After the initial success with these cables, we applied the same technology to power cables and the results were amazing. When my associates told me that our power cable and interconnects also work wonders on video projectors, I didn't believe them. But I was pleasantly surprised when I could see clearer, sharper, brighter, and more color balanced video images just by switching to our newly designed cables alone.

Truthfully, I still do not fully comprehend why it works so well. But, hey, *"Seeing is believing!"* Try our "Time Accurate" **Power** and **Component Video Cables** and see for yourself. The proof is in the video images! You can expect stellar performances from our other **"Time Accurate Cables"** as well.

If you are still skeptical about our theory, don't hold back your curiosity. However, let's not engage in a heated academic debate, because that would be unproductive. Instead, the best way to silence all B.S. is to do an "A vs. B" cable comparison test. I encourage you to take up our challenge. Because…

You deserve a more satisfying home theater experience!

Sunny Lo
Inventor