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Propagation speed meaning

Next: Vibrating Systems Up: Lectures Previous: Lectures To fully understand the different acoustic aspects of sound production, it is generally necessary to use complex mathematical methods such as calculus. However, it is possible to understand a lot about the physical aspects of sound production with only a few simple concepts. Distance of movement: a measure of the length between two points. Metric system used almost exclusively in this course. In two or three dimensions, a position is specified in terms of distances along each of two or three independent coordinates. Speed and speed: speed provides a measure of the distance travelled over a period of time. Velocity specifies both the speed of an object and the direction of travel. In one dimension, there is essentially no difference between speed and speed. Instantaneous speed is given by, where is displacement and is time. Acceleration: Acceleration is defined as the speed of change of speed. Immediate acceleration is given by . Newton's second law of Motion Force: Force = Mass x Acceleration: . The mass of an object is a measure of its resistance to acceleration. Mass and weight are often confused. Weight is the force of gravity on an object. Gravity causes objects to freefall with constant acceleration (9.8 meters/second on Earth). The weight of an object will vary depending on a certain gravity. However, an object will have the exact same mass for each gravity. Force is usually measured in Newton (kg meters/second). Pressure: Pressure is defined as the force perpendicular to a surface that is divided by the surface of that surface: . Pressure is a particularly useful amount to take into account when dealing with liquids (liquids and gases), such as air. The Spring Comparison (Hooke's Law) Force = Spring Constant x Displacement: . The constant is a measure of the stiffness of the spring. This linear relationship usually only applies to small movements. The Young's modulus and shear modulus of a material are proportionality constants that relate the resulting distortion to an applied external force. For liquids, a similar expression refers to a change in pressure or stress () and a resulting dilation or volume strain, given by a change in volume from the unflappable volume, via an elastic bulk modulus: . Work, Energy, & Power Work: Work = Force Distance (for a force that is constant in both size and direction). When an applied force causes an object to move, the force does the work. Work is usually measured in newton meters, or joules. Energy: In order to work, we need energy Energy comes in many forms, although in this course we will mainly focus on kinetic (energy of movement) and potential (stored) energy. An object of mass movement at a speed has kinetic energy given by . The same object held at a distance above the floor has potential energy , where is the acceleration of gravity. If the object then falls to the ground, the work of gravity would also be equal. When the object falls, potential energy is converted into kinetic energy. The final speed of the object just before hitting the floor can be determined by comparing gain from KE to loss of PE: Power: Power = Work/ Time. Power relates to the speed at which the work is done. The power is measured in watts (joules/second). Frequency, Wavelength, / Propagation Speed Frequency: The number of times that a given periodic phenomenon occurs within a certain interval. In acoustic contexts, we usually deal with the frequency of vibrations (of different media), which is measured in Hertz (Hz). Wavelength: Vibrations spread in the form of waves, which involves the transfer of energy through a media. The distance between successive waves is referred to as the wavelength. Reproductive speed: Vibrations travel at different speeds, depending on the media.. Reproductive rate, frequency and wavelength are related by the relationship: . Sound in the air travels at a speed roughly equivalent to 345 meters/second. Reproductive rate depends on the density and elasticity of a media. A more 'massy' material will have a lower reproductive rate. A 'stiffer' material will have a higher rate of reproduction. Reproductive rate Propagation rate: At best, the signals (rays) spread through free space at the speed of lignt (3*10**8 m/s). In contrast, the rate of reproduction by twisted pair of wire or coax is 2/3 of this value. The speed at which electrical signals can travel and limits as a percentage of the speed of light. As such it is usually at 2*10**8 m/s. Not also that the speed of 3 *10**8 m/s applies to the unguided media in general, except for salt water. Throughput: Speed of information arriving at, and possibly passing through, a certain point in a network system Time to Transmit a Bit Time to transmit a little: Time for transmitter to broadcast a single bit. The time it takes to physically place a little on the wire. It's the difference between when the bit starts to be placed on the thread until it's finished. For example, if a particular device can ship at a speed of 10 Mbps, the time it takes to send a single bit is 1*10**(-7) seconds. This is used to determine bit length. (See Homework for calculations!) Bit length Bit length: The length of the signal on the wire. Following the example above, because it takes 1*10**-7 seconds to get a single bit on the line and bit rate is 2*10 8 m/s, follows the Bit Length is (2*** 8)/(1* 10 ** 7) meters == 20 meters. (See Homework for calculations) Propagation Delay: There is always a short but finite delay for a signal (electrical, optical or radio) to spread (or travel) from one end of the transmission medium to the other. This is known as the Delay. While this may seem insignificant, this delay is important in some situations! It can be seen as the time it takes for a single bit to travel from one point to another, where the two points are the two ends of the medium. (See Homework to calculate reproductive delay!) Propagation Delay: Time needed for data to travel across a network, from source to final destination. Propagation Delay (Still a definition): Time taken by a signal to reproduce from transmitter to receiver over a communication medium. Transmission Time Transmission Time of a Frame (Packet, ...): Time for transmitter to broadcast a single frame. This is the time it takes to physically place a frame on the wire. It is the difference between when the first bit of the frame starts to be placed on the wire until the last bit of the frame is complete. Both transmission time of a frame and package are analogous to the Time to Transmit a bit. (See Bandwidth Usage Lecture Notes for illustration, example, and calculations!) Here's an illustration. Package time: Same as a package's airtime. Frame time: Same as the 100th time of a frame. Back-and-forth delay: Return delay is associated with a data link. It is the delay between the first bit of a block that is sent by the sender and the last piece of associated confirmation is received. (It is clear that this will be a function, not only of the time it takes to send the frame at the linkbit speed, but also on the reproductive delay of the compound.) Bit rate Bit rate: The number of bits per second sent or received. Data rate data rate: Same as bitrate bit error error error rate (BER): the measure of the probability that a bit will be received incorrectly. A BER of 10^(-5) means that on average one in 100,000 is damaged. Delay Processing: The delay that a package (frame, message) experiences during processing in an intermediate or end node, according to the protocol rules for that package (frame, message). Some examples include the time to do error checking (for the layers of the data link), mapping the target addresses of the package on outbound circuits and then ports, generating confirmations if such are defined for the protocol, sending the package to an outgoing circuit/port if this is not the final destination for the packaged. The speed factor (VF),[1] also called wave propagation speed or speed of reproduction (VoP or v P {\displaystyle v_{\mathrm {P} }}},[2] of a transmission medium is the rate at which a wave front (from an electromagnetic signal, a radio signal, a pulse of light in an optical fibre or a change in electrical voltage on a copper wire) passes through the middle, up to the speed of light in vacuum. For optical signals, the speed factor is the reciprocal Index. The speed of radio signals in vacuum, for example, is the speed of light, and thus the speed factor of a radio wave in vacuum is unit, or 100%. For electrical cables, the speed factor depends mainly on the insulation material (see table below). The use of the terms speed of reproduction and wave propagation speed to mean a ratio of speeds is limited to the computer networks and cable industry. In a general science and engineering context, these terms would be understood to mean a true speed or speed in units of distance per time,[3] while the speed factor is used for the ratio. Typical velocity factor speed factors are an important feature of communication media such as category 5 cables and radio transmission lines. Plenum data cable usually has a VF between 0.42 and 0.72 (42% to 72% of the speed of light in vacuum) and riser cable around 0.70. A VF of 0.70 corresponds to a speed of approximately 210,000,000 m/s or 4.76 ns per meter. Minimum speed factors for VF network cables (%) Cable Ethernet physical layer 74-79 Cat-7 rotated pair 77 RG-8/U Minimum for 10BASE5[4] 67 Fiber Optic Minimum for 10BASE-FL,[5] 100BASE-FX, ... 65 RG-58A/U Minimum for 10BASE2[6] 65 Cat-6A twisted pair 10GBASE-T 64 Cat-5th twisted pair 100BASE-TX, 1000BASE-T 58.5 Cat-3 twisted pair Minimum for 10BASE-T[7] Some typical speed factors for radio communication cables in manuals and texts are given in the following table:[8][9] VF (%) Transmissielijn 95–99 Open-wire Ladder Lijn 93 HJ8-50B 3 inch Heliax coaxiale kabel (luchtdiële elektriciteit)[10] 86 RG-8 Belden 7810A coaxiale kabel (gasgeïnjecteerde schuim high-density polyethyleen)[11] 83 RG-6 Belden 1189A coiale kabel, RG-11 Belden 1523A coaxiale kabel 82 RG-8X Belden 9258 coaxiale kabel (schuimed polyethyleen diëlektrische) 80 Belden 9085 twin-lead 77 RG-8/U generiek (geschuimd polyethyleen) 66 Belden 8723 twin shielded twisted pair stranded (polypropyleen isolator)[12] 66 RG-213 CXP213 (vaste polyethyleen diëlektrische) Berekening van de snelheidsfactor Elektrische golf VF is gelijk aan de wederkerige van de vierkantswortel van de diëlektrische constante (relatieve permittiviteit), κ {\displaystyle \kappa } of ε r {\displaystyle \epsilon _{\mathrm {r} }} , van het materiaal waardoor het signaal gaat: V F = 1 κ {\displaystyle \mathrm {VF} ={\frac {1}{\sqrt {\kappa }}}\ in het gebruikelijke geval waarin de relatieve doorlaatbaarheid , μ r {\displaystyle \mu _{\mathrm {r} }} , is 1. In the most common case: V F = 1 μ r ε r {\displaystyle \mathrm {VF} ={\frac {1}{\sqrt {\mu _{\mathrm {r} }\epsilon _{\mathrm {r} }}}}} with unusual magnetic conductive materials, such as ferriet. The speed factor for a lossless transmission line is given by: V F = 1 c 0 L ′ 'mathrm', {1} c_-mathrm {0} 'the C' 'L'C' per unit length), C′ {\displaystyle C'} is the capacity between the two conductors (in farads per unit length) and c 0 {\displaystyle c_{\mathrm {0} }} is the speed of light in vacuum. Optical wave VF is equal to the reciprocal reciprocity of the refractive index n {\displaystyle {n}} of the medium, usually optical fiber. V F = 1 n {\displaystyle \mathrm {VF} ={\frac {1}{n}}\ } √ See also Coaxial cable Propagation delay Signal speed speed of electricity Speed of equations of soundgrapher references ^ Gottlieb, I.M., Practical RF power design techniques, TAB Books, 1993, ISBN 0-8306-4129-7, p.251 (velocity factor) ^ Velocity of Propagation, General Cable Australia Pty Ltd, picked up 2010-02-13 ^ speed of propagation in Walker, P.M.B., Chambers Science and Technology Dictionary, Edinburgh, 1991, ISBN 1-85296-150-3 ^ IEEE 802.3 Clause 8.4.1.3 ^ IEEE 802.3 3 Clause 15.3.1.3 ^ IEEE 802.3 Clause 10.5.1.3 ^ IEEE 802.3 Clause 14.4.2.4 ^ H. Ward Silver, N0AX, ed. (2011). Chapter 22: component data and references. The ARRL Manual Radio Communication (88th ed.). ARRL, I don't know what to do. p. 22.48. ISBN 978-0-87259-096-0. ^ Kaiser, Kenneth L. (2005). Transmission lines, Matching and Crosstalk. CRC Press. 2–24. ISBN 9780849363627. ^ ^ ^ 8723 Multi-Conductor - Shielded Turned Couple Cable (PDF). Belden.com. 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