OPTIMIZATION METHODS IN ELECTROMAGNETIC RADIATION pdf

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This book considers problems of optimization arising in the design of electromagnetic radiators and receivers. The authors develop a systematic general theory that can be applied to a wide class of.

Units and Quantities Optimization Methods The goal of plan optimization is to find an optimal trade-off between inherently conflicting clinical goals given the set of treatment delivery limitations. This article details some methods in current use for create an optimal plan. Optimization Parameters Cost function Treatment planning involves a balancing act between competing clinical goals. For example, a target tumor should ideally receive a full prescription dose while the surrounding healthy organs should receive as close to zero dose as is achievable. The goal of all optimizers is to minimize the cost function by modifying the dose distribution within the constraints of clinical deliverability. Note that in this case, EUD reduced to mean dose. This approximates a maximum dose constraint. Leaf-sequencing is used to convert the optimized fluence map into a set of deliverable apertures. Leaf-sequencing results in a final fluence map which is sub-optimal compared to the optimized fluence map. Gradient-based optimization methods are sufficient to find the optimal fluence map. Gradient based methods use the derivative and second derivative of a problem to determine the direction of optimization. A global optimum fluence map can always be found because the cost function with associated delivery constraints is convex. For convex functions, a local minimizer is a global minimizer. Disadvantages of FMO The final dose distribution after leaf-sequencing is unlikely to represent the best possible dose distribution the machine could produce. Works Cited Bokrantz R. Multicriteria optimization for managing tradeoffs in radiation therapy treatment planning. The optimizer is directly constrained by machine limitations such as maximum and minimum dose rate, MLC leaf speed, gantry rotation speed, etc. Because of the additional constraints on the optimizer, the optimization problem is nonlinear and nonconvex meaning that a locally optimum solution is not necessarily a globally optimum solution. The difficulty in finding an optimal solution to a nonconvex problem requires advances optimization methods. Simulated Annealing Periodically introduces random changes to the variables. The optimizer evaluates the random changes and only retains those which improve the cost function. This allows the optimizer to escape from local minima in nonconvex problems. The idea of simulated annealing is taken from metallurgy where annealing, by periodically adding heat randomness , allows the metal to cool into harder lower energy states. Column generation methods Divides the optimization problem into subproblems, such as an individual aperture position, and attempts to optimize them. The optimizer then works on the global problem by optimizing segment weights. Gradient-based methods Uses the derivative and second derivative of a problem to determine the direction of optimization. DMPO produces a plan that has been optimized with actual machine parameters in mind yielding a more optimal final dose distribution than FMO. These DVH objectives and weights are, unfortunately, often not directly associated with the desired clinical goal. This means that traditional optimization is a time consuming trial-and-error process. Multi-criteria optimization attempts to resolve these issues by tying clinical desires more directly to optimization. Prioritized Optimization Clinical objectives are determined and ranked in the optimizer. When the plan is as good as it can be without making a trade-off. Pareto-surface is the set of all Pareto-optimal plans. The clinically optimal plan falls somewhere along the Pareto-surface. A Pareto-surface is generated by optimizing, usually by Direct Machine Parameter Optimization , a set of Pareto-optimal plans. These plans are then interpolated providing the set of plans along the Pareto-surface. The library method presents a small sub-set of Pareto optimal plans. The user may choose a plan for delivery or select several plans with desirable characteristics. The selected plans may be interpolated along the Pareto surface to generate additional treatment options. The graphic user interface method presents the user with trade-off sliders. This allows the user directly to explore the planning trade-offs to be made in Pareto optimal plans. Report a problem, request a feature, let us know how we can improve our content.

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2: Optimization Methods | Oncology Medical Physics

The subject of antenna design, primarily a discipline within electrical en- neering, is devoted to the manipulation of structural elements of and/or the electrical currents present on a physical object capable of supporting such a current.

Theory[edit] Shows the relative wavelengths of the electromagnetic waves of three different colours of light blue, green, and red with a distance scale in micrometers along the x-axis. Because the speed of EM waves predicted by the wave equation coincided with the measured speed of light , Maxwell concluded that light itself is an EM wave. In an electromagnetic wave, the changes in the electric field are always accompanied by a wave in the magnetic field in one direction, and vice versa. This relationship between the two occurs without either type field causing the other; rather, they occur together in the same way that time and space changes occur together and are interlinked in special relativity. Together, these fields form a propagating electromagnetic wave, which moves out into space and need never again affect the source. The distant EM field formed in this way by the acceleration of a charge carries energy with it that "radiates" away through space, hence the term. Near and far fields[edit] Main articles: Electromagnetic radiation thus includes the far field part of the electromagnetic field around a transmitter. A part of the "near-field" close to the transmitter, forms part of the changing electromagnetic field , but does not count as electromagnetic radiation. Currents directly produce a magnetic field, but it is of a magnetic dipole type that dies out with distance from the current. In a similar manner, moving charges pushed apart in a conductor by a changing electrical potential such as in an antenna produce an electric dipole type electrical field, but this also declines with distance. These fields make up the near-field near the EMR source. Neither of these behaviours are responsible for EM radiation. Instead, they cause electromagnetic field behaviour that only efficiently transfers power to a receiver very close to the source, such as the magnetic induction inside a transformer , or the feedback behaviour that happens close to the coil of a metal detector. This distant part of the electromagnetic field is "electromagnetic radiation" also called the far-field. The far-fields propagate radiate without allowing the transmitter to affect them. This causes them to be independent in the sense that their existence and their energy, after they have left the transmitter, is completely independent of both transmitter and receiver. Due to conservation of energy , the amount of power passing through any spherical surface drawn around the source is the same. Because such a surface has an area proportional to the square of its distance from the source, the power density of EM radiation always decreases with the inverse square of distance from the source; this is called the inverse-square law. This is in contrast to dipole parts of the EM field close to the source the near-field , which varies in power according to an inverse cube power law, and thus does not transport a conserved amount of energy over distances, but instead fades with distance, with its energy as noted rapidly returning to the transmitter or absorbed by a nearby receiver such as a transformer secondary coil. Whereas the magnetic part of the near-field is due to currents in the source, the magnetic field in EMR is due only to the local change in the electric field. In a similar way, while the electric field in the near-field is due directly to the charges and charge-separation in the source, the electric field in EMR is due to a change in the local magnetic field. Both processes for producing electric and magnetic EMR fields have a different dependence on distance than do near-field dipole electric and magnetic fields. Now independent of the source charges, the EM field, as it moves farther away, is dependent only upon the accelerations of the charges that produced it. It no longer has a strong connection to the direct fields of the charges, or to the velocity of the charges currents. This 3D animation shows a plane linearly polarized wave propagating from left to right. Note that the electric and magnetic fields in such a wave are in-phase with each other, reaching minima and maxima together. Electrodynamics is the physics of electromagnetic radiation, and electromagnetism is the physical phenomenon associated with the theory of electrodynamics. Electric and magnetic fields obey the properties of superposition. Thus, a field due to any particular particle or time-varying electric or magnetic field contributes to the fields present in the same space due to other causes. Further, as they are vector fields, all magnetic and electric field vectors add together according to vector addition. However, in nonlinear media, such as some crystals , interactions can occur between light and static electric and magnetic fields â€” these interactions include the Faraday effect and the Kerr effect. Light of composite wavelengths natural sunlight disperses into a visible spectrum passing through a prism, because of the wavelength-dependent refractive index of the prism material dispersion ; that is, each component wave within the composite light is bent a different amount. Both wave and particle characteristics have been confirmed in many experiments. Wave characteristics are more apparent when EM radiation is measured over relatively large timescales and over large distances while particle characteristics are more evident when measuring small timescales and distances. For example, when electromagnetic radiation is absorbed by matter, particle-like properties will be more obvious when the average number of photons in the cube of the relevant wavelength is much smaller than 1. It is not too difficult to experimentally observe non-uniform deposition of energy when light is absorbed, however this alone is not evidence of "particulate" behavior. Rather, it reflects the quantum nature of matter. Some experiments display both the wave and particle natures of electromagnetic waves, such as the self-interference of a single photon. A quantum theory of the interaction between electromagnetic radiation and matter such as electrons is described by the theory of quantum electrodynamics. Electromagnetic waves can be polarized , reflected, refracted, diffracted or interfere with each other. In homogeneous, isotropic media, electromagnetic radiation is a transverse wave , [20] meaning that its oscillations are perpendicular to the direction of energy transfer and travel. In dissipation less lossless media, these E and B fields are also in phase, with both reaching maxima and minima at the same points in space see illustrations. A common misconception is that the E and B fields in electromagnetic radiation are out of phase because a change in one produces the other, and this would produce a phase difference between them as sinusoidal functions as indeed happens in electromagnetic induction , and in the near-field close to antennas. However, in the far-field EM radiation which is described by the two source-free Maxwell curl operator equations, a more correct description is that a time-change in one type of field is proportional to a space-change in the other. The frequency of a wave is its rate of oscillation and is measured in hertz , the SI unit of frequency, where one hertz is equal to one oscillation per second. Light usually has multiple frequencies that sum to form the resultant wave. Different frequencies undergo different angles of refraction, a phenomenon known as dispersion. A wave consists of successive troughs and crests, and the distance between two adjacent crests or troughs is called the wavelength. Waves of the electromagnetic spectrum vary in size, from very long radio waves the size of buildings to very short gamma rays smaller than atom nuclei. Frequency is inversely proportional to wavelength, according to the equation:

3: Classical Electromagnetic Radiation - PDF Free Download

This book considers problems of optimization arising in the design of electromagnetic radiators and receivers. The authors develop a systematic general theory that can be applied to a wide class of structures.

The device comprises a crystal positioned in a channel undergoing a vibration, wherein an interaction between an incoming electromagnetic radiation and the vibration of the crystal optimizes a frequency of electromagnetic radiation. Also, a method comprising providing a channel, at least two parallel walls having an reflective surface; separating an incoming electromagnetic radiation into component frequencies; vibrating at least two parallel walls, wherein parallel walls contain at least one crystal capable of vibration; directing incoming electromagnetic radiation toward at least two parallel walls, wherein contact between incoming electromagnetic radiation and vibration of at least one crystal alters a frequency of electromagnetic radiation toward said optimal frequency. Field of the Invention The present invention relates to a device and method for optimizing and altering electromagnetic frequency using Doppler shifts of electromagnetic radiation, and, in particular, optimizing frequency for application to photovoltaic devices and the like. Related Art Photovoltaic PV devices operate optimally when incident electromagnetic radiation EMR has an energy that corresponds closely to the electron band gap of the PV material. Solar EMR is made up of a continuous spectrum of frequencies and wavelengths. When a photon with an energy less than the electron band gap of a given PV material, the photon lacks sufficient energy to move the electron from its valence band into the conductive band, and the PV material produces no electric current. Using a radiation source having an energy optimized for the particular PV material used in a solar cell array increases the efficiency of the PV material because less EMR is lost or wasted as heat, and more electricity is produced. Because of the rising demand for alternative energy sources, the need for an efficient alternative energy exists. A major deficiency in alternative energy sources, such as solar energy, include low rate of conversion of EMR to electricity. Therefore, a need exists for a device and method to increase efficiency of PV cells and avoid excess loss of EMR by altering and optimizing the frequency of incident EMR such that energy production in a PV cell is maximized. SUMMARY OF THE INVENTION A first aspect of the present invention provides an electromagnetic radiation optimization device comprising a crystal undergoing a vibration, said crystal positioned in an opening having walls, wherein an interaction between an incoming electromagnetic radiation and said vibration of said crystal optimizes a frequency of said electromagnetic radiation. A second aspect of the present invention provides an electromagnetic radiation frequency optimizing device comprising a first end having a separator positioned proximate said first end, a second end having a focusing member positioned proximate said second end, at least two opposed walls having an reflective surface, wherein said at least two opposed walls connect said first end and said second end, and at least one absorption area located on said reflective surface. A fourth aspect of the present invention provides providing a crystal undergoing a vibration, said crystal positioned in an opening having walls, wherein an interaction between an incoming electromagnetic radiation and said vibration of said crystal optimizes a frequency of said electromagnetic radiation, collecting said incoming electromagnetic radiation from a source through said first end, shifting the frequency of said electromagnetic radiation within said channel to achieve an optimal frequency of said electromagnetic radiation; and positioning a photovoltaic material a distance away from said channel. The scope of the present invention will in no way be limited to the number of constituting components, the materials thereof, the shapes thereof, the relative arrangement thereof, etc. The features and advantages of the present invention are illustrated in detail in the accompanying drawings, wherein like reference numerals refer to like elements throughout the drawings. Various embodiments of an electromagnetic radiation frequency altering and optimizing device of the present invention may optimize incident solar electromagnetic radiation 80 into an energy range that may be used in conjunction with a target, such as a photovoltaic material Incident electromagnetic radiation 80 may include radio waves, microwaves, terahertz radiation, infrared radiation, visible light, ultraviolet radiation, X-rays and gamma rays. Optimizing solar electromagnetic radiation 80 involves changing, altering, or shifting the frequency of the incident electromagnetic radiation 80 and therefore wavelength and energy level using Doppler shifts. By performing multiple Doppler shifts, a desired optimal frequency may be attained. A Doppler shift may change the frequency and wavelength of an incident electromagnetic radiation wave when the reflector is moving in relation to the incident wave. By coordinating or synchronizing the vibration of the plurality of crystals 17 comprising the inner reflective surface 15 and multiplying the effects of small Doppler shifts, an optimal electromagnetic radiation 85 may be obtained. Thus, the optimal electromagnetic radiation 85 has generally undergone blue or red shifts to achieve the desired optimal frequency before it is focused toward a target, such as a photovoltaic material The channel 5 may also be referred to as a Doppler channel, pathway, opening, conduit, duct, fluting, passage, pipe, tunnel, cavity or the like. The channel 5 may have a first end 10, a second end 20, a planar surface 7 connecting at least two side walls 25, Moreover, the channel 5 may have an inner reflective surface 15, described in more detail infra. The shape of the channel 5 may vary. A separator 12 is positioned within the channel 5. In one embodiment, the separator 12 may be positioned proximate the first end Also located within the channel 5 is a focusing member In one embodiment, the focusing member 13 may be positioned proximate the second end Furthermore, at least one absorption area 14 is located on the inner reflective surface In many embodiments, the channel 5 may have multiple absorption areas When the incident electromagnetic radiation enters the channel 5 at the first end 10, it may contact, pass through, reach, etc. The separator 12 may be any device capable of separating and directing incident electromagnetic radiation 80 into its component frequencies by refraction, diffraction, or filtering. In one embodiment, the separator 12 may be a prism. In another embodiment, the separator 12 may be a diffraction grating. In another embodiment, the separator 12 may be a system of filters. The separator 12 may also be any combination of the aforementioned devices. The separator 12 may separate incident electromagnetic radiation 80 into component frequencies and may direct the separated frequencies toward a side wall 25, 26 of the channel 5, with each frequency or group of frequencies targeted to a particular location within the channel 5. Furthermore, incident electromagnetic radiation 80 which may already be at or near the optimal and usable energy and frequency range for a particular target, such as a photovoltaic material 70, may be separated and directed by the separator 12 to travel straight through the channel 5, with minor incidental or no reflective interactions with the inner reflective surface As a result, the pre-optimal electromagnetic radiation 83 may be immediately directed toward the second end 20 and photovoltaic material 70, free from any frequency modification or alteration. The determination of whether the incident electromagnetic radiation 80 is near or at optimal frequency may depend on the particular photovoltaic material 70, and other variables known to those skilled in the art. Other frequencies of incident electromagnetic radiation 80, otherwise not useable by the photovoltaic material 70 may be separated and directed by the separator 12 to be reflected off the at least two side walls 25, 26 of channel 5, where it may interact with the inner reflective surface The interaction between the inner reflective surface 15 and the incident electromagnetic radiation 80 performs a Doppler shift to the otherwise unusable frequency for the photovoltaic material The Doppler shift performed on the incident electromagnetic radiation 80 may shift, alter, change, etc. In one exemplary embodiment, the separator 12 may separate and direct various frequencies of incident electromagnetic radiation 80 in different directions and may establish the reflection sequence which may result in the proper Doppler shifts according to the desired optimal frequency. Furthermore, a focusing member 13 is located proximate the second end 20 of the channel 5. The focusing member 13 may be any lens, grating, system of minors, a transparent medium, and the like. With continued reference to FIG. The incident electromagnetic radiation 80 that is separated and directed by the separator 12 may be called directed electromagnetic radiation A Doppler shift may occur when the directed electromagnetic radiation 81 interacts with the inner reflective surface 15 because of vibrating crystal atoms in the reflective surface The inner reflective surface 15 may be made up of a plurality of crystals 17, which may be suited for vibrating at high to ultra-high frequencies. Alternatively, the inner reflective surface 15 may comprise a single crystal suited to vibrate at high to ultra high frequencies. A crystal may be defined as a solid material whose atoms, molecules, or ions are arranged in a repeating pattern extending in all three spatial dimensions. The inner reflective surface 15 may contain ultra-high frequency vibrating atoms, which may or may not be made of crystals. Furthermore, the inner reflective surface 15, crystal, or plurality of crystals 17 may be comprised of Silicon,

SiO_2, $LiNbO_3$, GaAs, GeAsSe, BaF_2, ZnSe, ZnS, Al_2O_3, ceramics, metals, carbon, diamond, beryllium, iron, brass, copper, tin, nickel, chromium, magnesium, barium titanate, zinc sulphide, tourmaline, hydrogen phosphate, magnesium oxide, silicon nitrate, silicon carbon, hafnium or any combinations or mixtures thereof. It is noted that reflective gasses and liquids may also be used, for example, enclosed in Plexiglas, which could be used as a substrate or other structural material. In the various embodiments of the Doppler channel 5, the reflective crystal surface 15 may be attached, fastened, adhered, or otherwise affixed to the inner surfaces of the side walls 25, 26 of the channel 5. The reflective crystal surface 15 may also be grown by using techniques that are well known in the art, e. The side walls 25, 26 may be made of any material that provides rigidity, structure, and allows for adherence or growth of crystals, and resists the moderate heat levels that may develop when the channel 5 may be continuously exposed to the heat of the sun, or other sources electromagnetic radiation. Furthermore, the side walls 25, 26 may be smooth or may be uneven and rough, and may also be circular, rectangular, or may be just any practical shape. Accordingly, the side walls 25, 26 may be made out of materials including, but not limited to, a metal, a plastic or thermal resistant polymer, a suitable substrate for growing crystals such as silicon, and the like. In an alternative embodiment, the crystals may form the side walls 25, In yet another embodiment, where a single crystal is used, the side walls 25, 26 may be comprised of a single crystal. In another embodiment, a plurality of crystals 17 may be placed on a structural material, such as a substrate. The optimization device may only need a very thin shell to operate. For example, the thinnest material that possesses the desired characteristics and may be economical to machine manufacture might be the best material to act as a shell around the crystal or plurality of crystals The advantage of using a shell may be that less energy is required to achieve the vibrations of the crystalline atoms. However, if the optimization device does not need to be synchronized, or is designed to operate without synchronized vibrations, than any construction material may be used to support the inner reflective surface 15, the crystal, or the plurality of crystals In most embodiments, the crystals will be placed on a substrate to provide some support, which may be anything that does not adversely affect the performance of the crystals. In one exemplary embodiment, the crystals may be embedded in Plexiglas covers to provide support, and may allow the placement of the side walls 25, 26 and the separator 12 to be fixed. For example, the side walls 25, 26 and the separator 12 and focusing member 13 may be inserted in a panel of Plexiglas or they may be placed on a workboard which could be covered with Plexiglas. Positioned somewhere inside the channel 5, and located on the inner reflective surface 15 of the at least two side walls 25, 26 may be an absorption area 14, or a plurality of absorption areas This absorption area 14 may be used to absorb incident electromagnetic radiation 80 which would otherwise be wasted as heat. For example, the absorption area 14 may collect or absorb unusable electromagnetic radiation. Unusable electromagnetic radiation may be electromagnetic radiation that may not be utilized by the photovoltaic material 70, or any given target. This unusable electromagnetic radiation may be known as waste electromagnetic radiation As waste electromagnetic radiation 87 is absorbed by the absorption area 14, the temperature of the absorption area 14 may be increased. The absorption area 14 may be in conductive communication with the inner reflective crystal surface 15, thereby allowing heat generated by absorption of waste electromagnetic radiation 87 in the absorption areas 14 to be conducted to the reflective crystal surface 15, and raise the temperature of the inner reflective crystal surface As the temperature of the inner reflective crystal surface 15 rises, the atoms of the crystals may vibrate with increasing frequency. The vibrations of the crystal caused by the absorption of waste electromagnetic radiation 87 may optimize i. The absorption area 14 may be made of a non-reflective surface, any optically absorbing material, or any other material that may absorb electromagnetic energy and transform it to another form of energy, such as heat. The presence of at least one absorption area 14 or more than one absorption area 14 located throughout the channel 5 may allow the optimization device to be completely self-sustaining. No external power or energy need be used to power the vibrations of the crystals, although an external electric current may be applied to the channel 5 to heat the crystals and power the vibrations. For example, the incoming electromagnetic radiation 80 entering the first end 10 may be separated and directed and may come into contact with a spot on the surface of one of the side walls 25, 26 where an absorption area 14 is located. Thus, the absorption area 14 collects the waste electromagnetic radiation 87 which would normally be wasted as heat, or is unusable, and may use it to generate the vibrations of the crystals. Advantageously, the optimization device may operate without requiring energy output from an external source. Moreover, the waste electromagnetic radiation 87 may be harvested and utilized to generate the vibrations in a number of other ways such as directing the waste electromagnetic radiation 87 to select areas of the side walls 25, 26 which are not reflective, in particular, towards absorption areas 14, such that the waste electromagnetic radiation 87 energizes the crystals by the energy transferring by means of phonons throughout the crystal causing the desired vibrations. Also, the waste electromagnetic radiation 87 may be directed by a series of minors to the edge of the side wall 25, 26 to induce vibrations. Furthermore, the side walls 25, 26 may be constructed out of a substance which may reflect the higher frequencies but absorb the infrared portions of the spectrum, and this absorption may be utilized as the energy source for the vibrations. If a piezoelectric substance is utilized in comprising the side walls 25, 26, such as quartz crystal, electricity and a feedback loop may be applied to cause the substance to vibrate in a desired fashion. A feedback loop may obtain a constant oscillation. Although, small amounts of energy may be needed to maintain the vibrations in a quartz crystal, the potential energy output, especially if sunlight is concentrated towards the optimization device should exceed the energy needed to cause and maintain the harmonic vibrations in the crystals. It is noted that the energy produced by the solar cells prior to the activation of the optimization device may be more than sufficient to activate the constant oscillation which may energize the side walls 25, 26 the crystal atoms. Likewise, reflected electromagnetic radiation 84 is being both upshifted and downshifted, the net effect of the incident electromagnetic radiation 80, with respect to the channel 5, may be neutral. Referring again to FIG. Moreover, the difference between the speed of light and the speed of a vibrating atom in the channel 5 is so great that minor errors in calculated distances, d and L, may be harmless with respect to the Doppler interactions. The vibration speed of the atoms in the crystal surface 15 may vary depending on temperature. As the temperature rises, the atoms may tend to vibrate faster.

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Optimization Methods in Electromagnetic Radiation by Thomas S. Angell, Andreas Kirsch This book considers problems of optimization arising in the design of electromagnetic radiators and receivers, presenting a systematic general theory applicable to a wide class of structures.

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