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PERSPECTIVES

High Capacity Optical Channels for Bioinformation Transfer: Acupuncture Meridians

Jiří Pokorný [1,*], Tomáš Martan [1], Alberto Foletti [2]

[1] *Institute of Photonics and Electronics, Academy of Sciences of the Czech Republic, Prague, Czech Republic*
[2] *Laboratory of Applied Mathematics and Physics, Department of Innovative Technologies-DTI, University of Applied Sciences of Southern Switzerland-SUPSI, Manno, Switzerland*

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Abstract
Mammalian bodies are hierarchical systems whose internal cooperation and coherent activity require high capacity information transfer between the central control unit — the brain — and the periphery — the organs. A communication system capable of meeting information capacity requirements should be based on transmission of electromagnetic signals. Structures that fulfill requirements for such information transfer have not yet been analyzed. Acupuncture meridians have been demonstrated experimentally in some animals. They might represent systems of information transfer between the brain and the peripheral organs. The ducts of the meridians may correspond to optical fibers operating from the far infrared to the visible wavelength region. The main features of a model of the duct as an optical fiber are delineated and its properties outlined. However, to analyze essentials of the transmission capabilities, the whole meridian structure should be mapped and a more comprehensive set of physical parameters measured. In particular, experimental data concerning morphological arrangements of ordered water in the ducts and corpuscles, and a complete content of the biological particles in the flowing water and its permittivity are missing.

1. Introduction

This paper suggests novel aspects of large capacity information transfer that is necessary for highly organized structures and dynamic processes in mammalian bodies. The main features of molecular, genetic and neural information transfer have been described by Alberts et al. [1]. General questions of information transfer by information carrying biopolymers have been addressed by Crick [2], with an emphasis on the copy of the genetic code. The Crick concept may be used to explain enzymatic activity triggering a sequence of events [3], metabolic activity [4], kinetic co-operativity [5], and other material information transfers. An overview of the information transfer processes in biological systems can be found in reference [6]. Study of information transfer also includes models of the neural network with analysis of learning and thinking [6]. Neuronal interactions are dependent on neuronal synchronization that provides optimum conditions for information transfer [7]. The recent results show the ability

* Corresponding author. Institute of Photonics and Electronics, Academy of Sciences of the Czech Republic, Chaberská 57, 182 51 Prague 8-Kobylisy, Czech Republic.
E-mail: pokorny@ufe.cz

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of cancer to cause injury in distant healthy tissue by the physical mechanism of information transfer [8]. The changes in the tissue are triggered by biophotons emitted by cancer cells. Biophotons may propagate through the soft tissues, along nerve fibers, inside or along other convenient structures in the body. Biophoton transfer along the nerves of rats has been demonstrated experimentally [9].

Nevertheless, within the framework of bioinformatics, information transfer has to date been analyzed as a transfer of quality, or an order of entities [6]. Reduction to a quantitative basis has not been performed and, therefore, assessment of the amount of information or channel capacity has not been possible.

Information may be transferred on principles of horizontal and vertical (hierarchical) organization permitting cooperation. However, bioinformation transfer might be repleted with multiplicity, overlapping, time and space dependent features, and different and changing ascendancy. Mammalian bodies are hierarchical systems whose internal cooperation and coherent activity require high capacity information transfer between the central control unit — the brain — and the periphery — the organs. It is well known that material and energy supplied to hierarchical systems are processed, divided, and supplied to various regions according to their needs. Processes of biological activity have to be controlled and coordinated by central regulation across hierarchical levels (but the functions of individual parts are subject to autonomous local controlling mechanisms too). The brain must be informed about the state of individual parts, process received information, and send controlling signals to the individual parts of the body that are under its surveillance.

The pathological state of the body or its parts should be discerned on the basis of information that is sent to and received by the brain. It may extract essentials from received information and decide upon a convenient action to adjust the healthy state. For instance, body temperature is increased to fight microbial infection.

The function of the brain is under intensive study, but the systems for information transfer in mammals should also be investigated. Mechanisms controlling basic functions such as mechanical motion are based on neural activity [1]. Although a similar mechanism transfers pain information, regardless of the amount of information transferred by neural systems and material means, information transfer capacity does not seem to be sufficient for the necessary control of brain function. The information system based on biophoton transmission may have enormous capacity, but such a system for transfer of information and controlling signals has not yet been disclosed.

2. Communication system

Communication in a living body provides information transfer between its individual parts — the organs — and the brain (and vice versa). Before analyzing communication in a biological system, the classical communication systems in human society are outlined [10a,11], because communication between the body and the brain for information transfer and signal processing might be similar. Communication systems consist of an information source producing a message, a transmitter transforming the message to a signal suitable for transmission over the channel, the channel transmitting the signal to the receiver, the receiver reconstructing the message, and the destination organ processing the message and extracting relevant information and making a decision. Information transfer depends on the channel capacity [10b,12]. The quantum effects on information transfer have been described by Yu [13]. Information transfer between oscillation systems of the biological type has been described by Pokorny and Wu [14].

The brain should obtain information about different organs, their physiological states and structural changes, processes under way, and deviations from the normal, healthy state, that is, information about disease. It is an open question whether a message from an organ to the brain can contain discernible information about each cell in the organ or only general features of its function. The human body is organized as a hierarchical system with distinct levels. For instance, information about cells and organs should be partitioned and processed at corresponding control levels. The hierarchical partitioning systems are probably in the brain. Therefore, the signals containing information corresponding to different hierarchical levels are simultaneously transferred by the communication system. This may be a special property of the biological communication system. Communication between the brain and body should organize functional cooperation between different organs, adjust coherence, send feedback messages to correct disturbances, and treat diseases. The brain should be informed about impaired cells that might endanger the function of the organ or even the whole body. The human body consists of about 10^{14} cells, therefore, the communication system must transfer a large amount of information. On the other hand, Fröhlich has assumed that electrodynamic activity of each organ is connected with energy condensation in a normal mode whose frequency is the same in all cells [15—20]. As a result of a pathological state, the frequency might be changed in some cells [19], a wide frequency spectrum might be generated, and a large amount of information transfer might be needed. With respect to the required information transfer, the classical neural and molecular transfer systems do not seem to be convenient for this task. Adequate information transfer might be provided by electromagnetic signals. Therefore, the assumption that the brain may be informed about each individual cell in the body may be plausible under the conditions of a corresponding capacity of the information channels.

The essential parts of the communication systems in the human body, namely the source of information, the transmitter, and the channel transferring signal to the receiving part in the brain are discussed. The cellular electromagnetic field seems to be a source of information because it represents the biological activity of the cell. First, the main features of the cellular electromagnetic field need to be mentioned [14,21—25]. Inside the cell, electrical polar oscillations of microtubules generate an oscillating electric (electrodynamic) field that mediates long-range interactions. In a cell, there are about 100 microtubules bound to membrane structures. Microtubules are the main organizers of the cytoskeleton and the cell. If each isolated microtubule oscillates at one frequency, the cellular electric

(electrodynamic) field might consist of a group of spectral lines whose number might be related to the number of microtubules in the cell. Nevertheless, in nonlinear systems, the number of spectral lines may depend on the specific nature of the nonlinear properties, and a highly excited coherent oscillation mode may be formed. If a spectrum were formed, the distance between the spectral lines would depend on the strength of interactions between oscillations in the microtubules. The interaction coefficient is a function of the amplitudes of oscillations (i.e., of the power of the oscillations). The electric (electrodynamic) field might form a cellular spectral pattern that may represent a characteristic feature of the cell.

In a similar way, a spectral pattern of the tissues may be created. About 10^9 cells are contained in a volume of about 1 cm^3 of tissue. As the cells in an organ may have equal properties, the cellular spectral patterns of individual cells should be identical. Formation of the spectral lines in a tissue and a cell is governed by the same law, but the strengths of interactions differ. Due to interactions between cells, a complicated frequency spectrum of the tissue may be formed. The tissue spectral pattern should contain patterns of all cells in the surveyed region of the tissue. If the bandwidth of the cellular spectral patterns is about 100 Hz, the bandwidth of the spectral pattern of the assumed tissue volume might be about 10^{11} Hz (but nonlinear properties may modify the width and the character of the spectral pattern). This spectrum may represent information about all cells in the organ, its composition, function, and state of health or disease. The transferred electromagnetic signals provide the brain with a large amount of information, which might hugely exceed the level provided by neural and molecular means.

The tissue signal might be collected by a convenient system playing the role of a transmitter. The collected signal may be transferred to a channel and sent to the control unit. The possibility of whether the acupuncture meridians disclosed in some animals might form a convenient system for information transfer, as suggested by Soh [26], is assessed.

3. Acupuncture meridians

Acupuncture technology has been known for thousands of years, but the nature of acupuncture points and meridians remains in the realm of mystery. Anatomical structures corresponding to the classical acupuncture meridians have been observed in mice [27—29], rats [28,30—33], rabbits [28,34—37], and pigs [38]. These findings confirm the discovery by Bong-Han Kim, who has found special ducts and corpuscles forming a meridian network distributed throughout animal bodies (the experimental data were published in 1963). The ducts and corpuscles (Fig. 1) — the discernible parts of the meridian system (described in [27] and [28]) — exist in the skin of animals, in the blood and lymphatic vessels, and on the surfaces of internal organs. Visualization of the acupuncture meridian structures is performed, for example, by staining with acridine orange [28,30,39], propidium iodide and Alcian blue [27], Trypan blue [33,40—42], Janus Green B method [34], or by the Feulgen reaction [43].

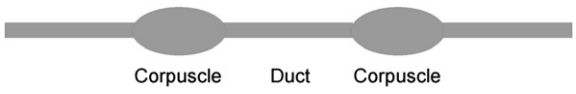


Figure 1 A schematic picture of an anatomical structure of a part of a meridian composed from ducts and corpuscles.

The ducts have been confirmed in the blood vessels of rabbits, rats and pigs, and in the large lymphatic vessels of rats and rabbits [27]. The ducts are tubular structures whose diameter is 10—20 μm. Inside the ducts, special rod-shaped nuclei about 10 μm long are distributed in a broken-line striped fashion. There are long and narrow lumens in the ducts that are considered to be the sub-ducts that form a bundle-like structure. The corpuscle is a voluminous oval shaped body whose dimensions are 110 μm × 65 μm × 65 μm [28]. The corpuscle is connected at both its ends to the ducts. The corpuscles have been found in mice, rats and rabbit aortas, and in the inferior vena cava wall of mice. Many large sinuses are present in the cross-section of the corpuscles. One-way liquid flow through a duct—corpuscle system has been demonstrated by injection of fluorescent nanoparticles into a corpuscle at the organ surface. The average flow speed through the duct measured by injection of Alcian blue into a corpuscle on the surface of a rabbit liver is about 0.3 mm/second [40,44]. The fluid contains biological molecules and particles, for instance, hyaluronic acid, hormones such as adrenalin, immune cells (macrophages and mast cells), cell-like bodies, and globular structures that may be flowing microcells of about 1 μm in size [44].

The function of the anatomical corpuscular and duct structures has not been verified experimentally, but Soh [26] has suggested that the duct "is an optical communication channel to keep coherence in the whole body by utilizing biophotons produced in cellular processes."

4. Optical fibers

One of the first experimental demonstrations of waveguide properties of flowing water was shown to the Royal Society by English physicist John Tyndal in 1854. Tyndal demonstrated the phenomenon of light guiding through a curved stream of water. Essential physical properties of the structures guiding electromagnetic waves — the dielectric wires — were analyzed by Hondros and Debye [45]. The wire guiding electromagnetic waves has permittivity greater than that of the ambient medium. Electromagnetic waves may propagate in the area around the wire in radial and axial directions. Electromagnetic signals may be trapped in the wire and propagate along the axis due to the total reflection phenomenon. A simple model of a dielectric wire with a radiating and a wire (core) mode is shown in Fig. 2A.

Essential properties of optical fibers have been analyzed on the basis of the dielectric wire theory. Fundamental information about optical fibers has been described by Unger [46]. At the present time, optical (silica) fibers are especially used as a medium for data transmission in telecommunications. The inner structure of such optical fibers is divided into two areas. The first central area called the core has permittivity ε_D (Fig. 2B). As the medium with

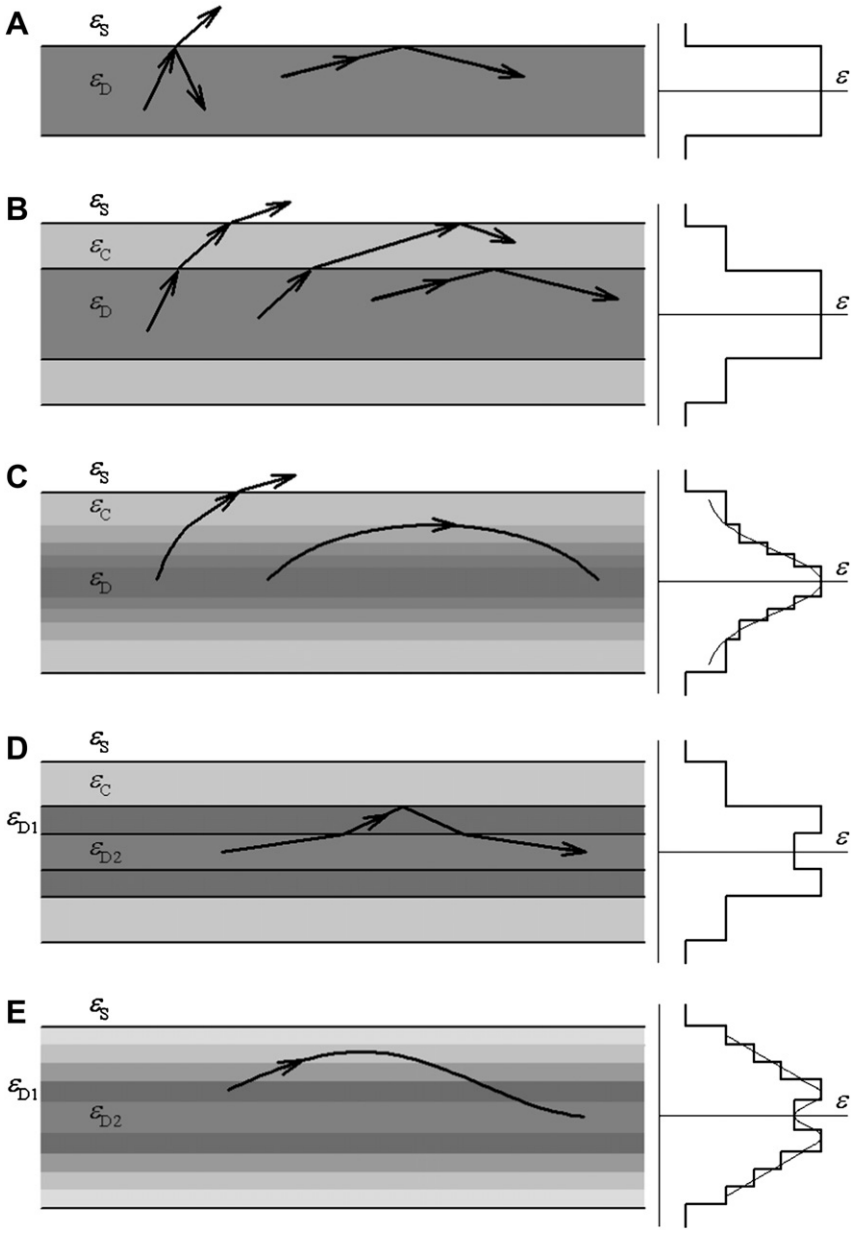


Figure 2 A schematic picture of transversal structures of dielectric fibers transmitting electromagnetic signals. Permittivity of the core of the fiber, of the cladding, and of the surrounding medium are, respectively, ε_D, ε_C, and ε_S, fulfilling the waveguide condition $\varepsilon_D > \varepsilon_C > \varepsilon_S$. Permittivity of the core has uniform (A, B) and nonuniform symmetrical transversal (C—E) distributions. Reflection, refraction, and diffraction of the electromagnetic signals are visualized by the full lines with arrows. Profile of the permittivity (denoted by ε) as a function of the radius r is on the right hand side of each picture. (A) Dielectric wire: transmission of the signal to the surrounding medium (radiating mode) is on the left and the total reflection, that is, the guided wire (core) mode on the right hand side. (B) Core structure with fiber cladding: total reflection at the boundary between the cladding and the surrounding medium is shown in the middle (cladding mode). (C) Graded-index (permittivity) structure: direction of propagation in the core is gradually diffracted by the permittivity profile changes. (D) Schematic picture of a hypothetical step-index coaxial structure: a dip of the permittivity profile along the axis is shown. (E) Graded-index (permittivity) structure with a dip of the permittivity profile along the axis.

permittivity ε_S around the fiber may fluctuate and degrade the propagating waves, the core of a communication fiber is surrounded by cladding with permittivity ε_C. The cladding forms the secondary area. The permittivity (index of refraction) of the fiber core has to be greater than that of the cladding to guide individual electromagnetic modes along the fiber. This type of fiber is called the step-index fiber. The next condition for light guiding is the critical angle. Light is guided if the angle between the incoming ray of light and core—cladding interface is smaller than the critical angle. Such rays are guided by total internal reflection, and the so-called evanescent wave is guided along the core—cladding interface. The radiating, the cladding, and the core mode are shown in Fig. 2B. The

step-index fibers can be further divided into single-mode and multiple-mode fibers.

The propagation constant k of electromagnetic waves in a medium with permittivity ε ($\varepsilon = \varepsilon_0\varepsilon_r$ and $\varepsilon^{1/2}$ is the index of refraction) is $k = \omega(\mu\varepsilon)^{1/2}$, where ω is the circular frequency and μ is the permeability. In a dielectric fiber, the propagation constants in axial and radial directions are Γ and γ, respectively. Light can also be transmitted by a waveguide whose schematic picture is shown in Fig. 2C. This optical fiber has a graded-index (permittivity) structure that causes diffraction of propagating electromagnetic waves. The refractive index is approximately parabolic. This type of fiber works like configuration of lenses that focus guided modes. Therefore, this type of fiber is also called a self-focusing fiber. This effect reduces mode dispersion that is caused by different velocities of propagation of guided modes.

The fiber is capable of transferring electromagnetic signals through the structure of the fiber. Wavelength bands transmitted by a fiber depend on the dimension of the core and ratio between refractive indexes (permittivity values) of the core and the cladding.

The ducts may be assumed to form fibers with circular cross-sections of the radius of about 10 μm. Optical fibers are technical communication systems whose material composition is different from that of meridians, but the physical principles have to be essentially the same. Comparison of the ducts with optical fibers for communication systems (with corresponding parameters) may help to assess their communication capability in biological systems. The axisymmetric modes will be analyzed ($n = 0$). Frequencies of the modes may be evaluated using characteristic equations for TE (transverse electric) and TM (transverse magnetic) modes in the form

$$\frac{J_1(\gamma_1 a)}{\gamma_1 a J_0(\gamma_1 a)} = -\frac{H(\gamma_2 a)}{\gamma_2 a H_0(\gamma_2 a)}, \quad \frac{\varepsilon_1 J_1(\gamma_1 a)}{\gamma_1 a J_0(\gamma_1 a)} = -\frac{\varepsilon_2 H_1(\gamma_2 a)}{\gamma_2 a H_0(\gamma_2 a)},$$

respectively, where a is radius of the duct, γ_1 is propagation constant in the wire (core), and γ_2 in the cladding. Modified Hankel functions were not used because we did not assume that evanescent waves in the cladding would be important in the ducts.

The frequencies (wavelengths) of the axisymmetric TE and TM modes are shown in Table 1. Permittivity of the core is 1.5, 2.0 and 2.5 and that of the ambient medium (cladding) is 1.3. The lowest mode frequency is in the far infrared region (of the order of magnitude of 10 THz and higher). The greater the permittivity of the core, the lower the mode frequency. The mode frequency increases with the sequence number m_H (integer), which denotes the points where the imaginary part of the Hankel function term in the characteristic equation equals $m_H\pi$. For higher m_H modes, the frequency may reach the visible region. The nonaxisymmetric modes (for $n > 0$) are the hybrid modes, which are not of the TE and TM type. These modes have components of the intensity of the electric and magnetic field in the axial direction.

5. Model of the duct as an optical fiber

A wide variety of permittivity profiles have been designed in technological research and produced for telecommunication.

Table 1 The frequency ν and the wavelength λ of the axially symmetric modes ($n = 0$) in a circular dielectric core with a radius of 10 μm and relative permittivity ε_{D1}, ε_{D2}, and ε_{D3}. The relative permittivity of the surrounding medium (cladding) is 1.3. Integer parameter m_H denotes sequence number of the points where the imaginary part of the Hankel function term in the characteristic equation equals $m_H\pi$. γ_1 and γ_2 denote the constants of propagation in the radial direction in the dielectric core and in its surrounding medium, respectively (when $m_H = 0$ then $\gamma_2 = 0$ and $\gamma_1 \neq 0$). θ_P is the polarization angle (the critical angle for total reflection at the core-cladding boundary). θ is the angle of incidence determined from the propagation constants k and γ_1.

m_H	$\varepsilon_D = 1.5$			$\varepsilon_D = 2.0$			$\varepsilon_D = 2.5$		
	$\theta_P = 69$ (°)			$\theta_P = 54$ (°)			$\theta_P = 46$ (°)		
	ν	λ	θ	ν	λ	θ	ν	λ	θ
	(THz)	(μm)	(°)	(THz)	(μm)	(°)	(THz)	(μm)	(°)
0	26	12	69	14	22	54	11	29	46
1	68	4.4	82	37	8.2	72	28	11	75
2	96	3.1	84	51	5.8	81	39	7.7	79
3	384	0.8	67	206	1.5	52	157	1.9	43

Optical fibers are dielectric waveguides transmitting information in single or multiple modes. The diameter of the core of a single-mode and multi-mode fiber is about 8 μm and 50 μm, respectively. The core of a single-mode or multi-mode fiber is surrounded by cladding with an outer diameter of 125 μm. These fibers can be used for telecommunications, but tapered optical fibers with an outer diameter of 10 μm can be used for special applications [47].

On the basis of technological types of fibers, hypothetical models of ducts have been analyzed. A similar structure may be formed in the meridians in mammalian bodies. Similarities between telecommunication optical fibers and the mammalian ducts will be shown. Therefore, the optical fiber may be taken as a model waveguide that could, in principle, be used to explain the functionality of the ducts of meridians.

The ducts have an outer diameter of 10–20 μm. The thickness of the walls may be 0.1–1 μm. The ducts are filled with ordered water and biological "particles" of micrometer dimensions or smaller. For simplicity, we take ducts as simple waveguides (without inner structures), which are made by the core (ordered water) that is surrounded by cladding (walls of the ducts). If the duct transmits electromagnetic waves, it must fulfill the waveguide conditions. The effective permittivity (index of refraction) of the core must be greater than the permittivity (index of refraction) of the cladding. The conditions provided by biological systems will be assessed. For instance, water with 5% concentration of γ-globulin at 37 °C has an index of refraction of 1.3393, corresponding to permittivity of 1.7937 [48], and the index of refraction of the wall may be about 1.2247 (permittivity, 1.5). Therefore, condition $\varepsilon_D > \varepsilon_C$ is fulfilled. From these conditions, one can see that ducts in meridians could transmit many (bands of) modes. This means that the parameters of the ducts can be compared with those of multi-mode fibers.

Another important point concerns the principle of wave guiding.

The thickness of the duct walls is practically negligible from the point of view of expected guided modes. The duct walls are very thin and, therefore, it can be assumed that its function is primarily to guide the ordered water and to create the capillary effects. The velocity of the quasi-ordered water flowing inside the ducts can be influenced by the capillary forces if the duct diameter is changed. For comparison: in the case of the step-index optical (multimode) fibers, the thickness of the cladding (with outer diameter about 37 μm) is sufficient for attenuation of evanescent waves. With respect to thin duct walls (i.e., thin cladding) the total reflection is not a probable mechanism due to high energy losses of guiding waves. More probable waveguide principles are based on diffraction of waves if the core (quasi-ordered water) has a non-homogenous distribution index of refraction (Fig. 2C). Guided electromagnetic signals of different wavelengths are diffracted sooner than when they reach the core—cladding boundaries. This means that the intensity of the evanescent wave at the boundary of the core—cladding is lower than in the case of total reflection. Moreover, the other advantage of a self-focusing core is the reduction of mode dispersion, as mentioned above.

Nevertheless, it should be mentioned that the permittivity inside the duct may display peculiar distribution dependent on: the velocity of water flow; attraction and repulsion forces between biological particles with the surrounding envelope of ordered water; the effects of the walls; and the round shape of the nuclei. A drop in permittivity may appear along the axis of the structure. The highest permittivity region may be shifted from the central part of the axis. A schematic picture of a step-index and a graded-index profile with permittivity decrease along the axis is shown in Fig. 2D and 2E, respectively.

Further measurements would supply experimental data for a more comprehensive analysis of the meridian function.

6. Discussion

Acupuncture meridians have been shown experimentally to be special anatomical structures in mice, rats, rabbits and pigs [27—38], but their biological function is unclear. In this paper, the acupuncture meridian system is assumed to provide a fast and high capacity transfer of bio-information in mammals on the basis of electromagnetic signals. Measured electrodynamic fields of living cells [49] and photon emission by biological systems [50—53] indicate their significance in biology. These measurements support the idea of photon information transfer through meridians, but only a small part of the meridian systems is anatomically and morphologically specified. Physical and biochemical data about these systems are also insufficient because only some parameters have been measured. Measured composition of the flowing liquid suggests that water in the ducts and corpuscles may be considerably ordered. Layers of the highly ordered phase of water (interfacial water [54]) may exist at the inner walls of the duct and corpuscles. Thickness and ordering of the interfacial water depends on the surface charge of biological particles and structures [54—59]. Permittivity of the ordered water annular layer in ducts may depend on the ordering level, that is, on the surface charge too. In the axial part of the duct tube, biological liquid flow may provide specific conditions. The liquid contains biological molecules and particles. Due to the hydration effect, interfacial water clusters move in the tube in the axial direction. If the linear dimensions of the clusters are smaller than the wavelength of the propagating electromagnetic signals, and the scattering may be neglected, permittivity of the liquid differs from that of the bulk water. Permittivity in the axial region may vary with the content and properties of biological particles, and probably also with the flow velocity. Permittivity of water with ordered clusters may vary according to the content and properties of biological particles, as may be assessed by the data of Drost-Hansen [48].

The anatomical data describe morphology and dimensions only of limited parts of the meridian system. Physical properties such as the surface charge of the duct tubular walls and ordering of the inner liquid are not known. A full biochemical analysis of the liquid flowing through the ducts has not yet been done.

The function of corpuscles is not clear. The corpuscle may serve as a structure that collects the electromagnetic signals of the tissues from organs and transfers them to the duct for transmission to the brain. They may also fulfill a role as electromagnetic resonators. The corpuscle may amplify the collected and transferred signals (microtubules in a cell could amplify electromagnetic signals [60]). However, this is only one of the unknown features. Visualization of morphological structures of the ordered water at the inner walls of the ducts and corpuscles, disclosure of the function of the rod-shaped nuclei, biochemical analysis of a complete composition of the flowing liquid, and measurement of its permittivity are important topics for further research.

The ducts and corpuscles might fulfill a function of optical channels with dielectric walls operating from far infrared to visible wavebands, that is, in the frequency range 10^{13}—10^{14} Hz. Different electromagnetic modes might be utilized for signal transfer; the bandwidth of the transmitted signals may be large. Therefore, the meridian system may provide transfer of a sufficiently wide spectrum of electromagnetic signals from the organs to the brain and vice versa. The transferred signals may coordinate processes in the whole body and provide functional harmony.

The capacity of the channels based on photon transfer may be analyzed using quantitative methods as in standard communication systems [10b,12]. The amount of transferred information depends on the ratio of the power of the transmitted signal and power of the noise, and on the frequency band. The capacity of the photon channels may be extremely high.

This article contains only a preliminary treatment of the problem of information transfer, but we may conclude that acupuncture meridians might be structures that serve as high-capacity channels for information transfer by electromagnetic signals in mammals. Further research would disclose whether the permittivity of the inner duct part (core) meets the requirements outlined in this paper.

7. Conclusion

Although the controlling function of the brain in mammals must be based on high-capacity information transfer between the brain and the corresponding parts of the body, analysis of the main issues of such information transfer and the channel medium is still inadequate. Even the nature of high-capacity communication channels in biological systems is unclear. Information transfer may be based on transmission of photons. Photon propagation in a special medium — optical fibers — is widely used in telecommunications. This paper presents a model of a possible role of acupuncture meridians as the channels for information transfer by electromagnetic signals. Acupuncture meridians have been shown experimentally to be anatomical structures composed of ducts and corpuscles [27—44], but their function in biological systems is unclear. They could serve as a telecommunication medium for a control function of the brain. Therefore, the brain may collect information flowing from the body and send control "orders" through the duct—corpuscle system. The meridians may operate as high-capacity electromagnetic communication channels from the far infrared to the visible region. The proposed meridian model corresponds to a special structure of optical fibers used for communication purposes. Nevertheless, experimental parameters are not sufficient to prove or disprove the role of meridians in photon information transfer.

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