ОПТИМИЗАЦИЯ РАСПОЛОЖЕНИЯ ИСТОЧНИКОВ ПРИ ЭЛЕКТРОИМПУЛЬСНОМ ДРОБЛЕНИИ

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The object of the work is the process of hard fractions' crushing in liquid mixture by a series of electric impulses. Purpose of the work is construction optimum location of electrodes in a work area to determine maximal area of coverage by impulsive influence. Simulation techniques and gradient optimization methods are chosen as the methods of research. The calculations are realized in Mathematica-5.0 environment. During research the great increase of crushing area is obtained. For the given object optimization problem is new and claimed.

Рассматривается процесс обработки жидкой смеси твердых фракций, приводящей к разрушению частиц, содержащихся в этой смеси. Целью этих разрушений является получение из больших частиц отдельных фракций – компонент смеси частиц заданного диаметра, которые могут быть использованы в дальнейшем.

Целью данной работы является оптимизация конфигурации и местоположения блока электродов для процесса дробления. Это - процесс получения более мелких фракций (лежащих в необходимых пределах) из более крупных компонент смеси, вследствие воздействия на данную смесь серии электрических импульсов с заданными характеристиками. Электрические импульсы подаются на рабочий элемент специальной электроимпульсной установкой посредством многопроводных электрических кабелей. Задача ставится впервые; решение и его техническая реализация требует минимальных затрат.

Для её решения строится модель процесса и рассматривается расположение рабочих элементов (электродов) непосредственно в области дробления с целью получения как можно большего объема фракций компонент жидкой смеси, находящихся в пределах заданных размеров. Качество дробления определяется суммарной мощностью импульса гидравлического удара в данной точке.

Математическая модель и задача оптимизации.

Пусть D – сечение цилиндрического реактора-ванны со смесью;

(x_i, y_i) – координаты источников импульсов в D; $x_i \neq x_j$, $y_i \neq y_j$ $\forall\ i \neq j$;

$(x, y) \in$ D – координаты точек дробления; $\Delta x_i = x - x_i$, $\Delta y_i = y - y_i$.

Интересующая нас область дробления $\Omega \subset$ D, во всех точках которой размеры частиц твердой фракции удовлетворяют заданным технологическим ограничениям. Они задают двусторонние ограничения на мощность

$$\Omega: \ \{(x, y) \mid M_1 \geq \mathrm{P}(x, y) \geq M_2\} \qquad M_{1,2} - \text{const} \tag{1}$$

То есть, область Ω состоит из всех точек (x, y), для которых верно (1), и ими определяется. Ее форма зависит от конфигурации источников и их места. Она заранее не известна, может иметь очень сложную форму, и подлежит определению в процессе оптимизации. Пусть $S(\Omega)$ – ее площадь.

Тогда общая постановка задачи оптимизации имеет вид

$$\Omega = \Omega\ (\mathrm{D},\ (x_i, y_i),\ M_1, M_2) \qquad\qquad \mathrm{S}(\Omega) \to \max$$

Принято считать, что мощность импульса убывает с расстоянием r от электрода как K/r^2, где $K < 1$ – определяет затухание в результате поглощения в смеси. Пусть M_0 – мощность источника импульсов; k – количество электродов. После нормирования на M_0K, выражение (1) имеет вид:

$$\mu_1 \geq \sum_{i=1}^{k} \frac{1}{\Delta x_i^2 + \Delta y_i^2} \geq \mu_2. \tag{2}$$

Необходимо максимизировать целевую функцию S(Ω) – площадь области, для которой выполняется условие (2). Она зависит от $\{(x_i, y_i)\}$ – расположения электродов в области D.

$$\Omega = \Omega(D, (x_i, y_i), \mu_i) \qquad S(\Omega) \to \max \qquad (3)$$

Кроме того, значения целевой функции зависят от подаваемых на электроды импульсов, величины затухания в смеси и отражающей способности стенок реактора, которые в данной задаче постоянны. Технологические ограничения, связанные с неналожением электродов, $\forall\ i \neq j \quad \rho((x_i, y_i), (x_j, y_j)) > \rho_0$ при реальных μ_i обычно не активны. Диаметры электродов на два порядка меньше любого из геометрических размеров реакторной ванны, т.е. они считаются точечными в сечении D.

Задача оптимизации *S* в данной работе рассматривается для областей D вида :

- круговой, радиуса *R*, с пакетом электродов в виде правильного треугольника, размер которого варьируется;
- прямоугольной, с размерами d_1 и d_2 , с пакетом электродов в виде произвольного треугольника, размеры которого и местоположение в D варьируются;

границы области D:

- поглощающие (отражения не учитываются);
- слабо отражающие (учитывается однократное отражение с коэффициентом $\theta < 1$).

Заданы:

- мощность импульса на электроде M_0;
- параметры области дробления: *R*- для круга, либо *d*1, *d*2 – для прямоугольника; они на два порядка больше диаметра электродов;
- мощность импульса, при котором происходит необходимое дробление, – в пределах $M_1 \div M_2$.

Для дробильной установки могут быть использованы схемы с различным количеством электродов. Воздействие характеризуется нерезонансным наложением, результатом которого есть суммирование мощностей волн.

Для математического моделирования используем координатную систему, началом координат которой является центр области дробления. Тогда первоначальные координаты электродов задаются либо:

– с помощью лица принимающего решения (испытателя).

– случайным образом.

Область дробления, оптимизация которой производится, представляет собой плоское, возможно многосвязное множество, для всех точек которого выполняется неравенство (2). В качестве параметров – оптимизационных переменных, связанных с целевой функцией используются координаты рабочих элементов в области и подаваемые на них напряжения. Кроме того, одним из факторов, влияющих на «полезную» площадь, является отражающая способность стенок, поэтому в данной работе также проводилось исследование оптимальной конфигурации электродов при однократного отражения с коэффициентом $\theta = 1/2$.

Результаты оптимизации для трех электродов в круглой ванне приведены в таблице.

Геометрия	*S*(Ω) в % от *S*(D)
Первоначальная	13
Оптимальная	40

Метод и компьютерная программа, при незначительной доработке, в дальнейшем будут применены для оптимизации конфигурации произвольного количества электродов в ванне любой формы с более сложным законом затухания и отражения от стенок. Это сулит определенный экономический эффект.

EFFECTS OF MOBILE PHONE MASTS ON THE ENVIRONMENT: EXAMINING PROBLEMS OF THE NEW CIGARETTE

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The given work is devoted to examining the effects of mobile phone usage on the health of humans. It links the problems associated with using mobile phones as a trendy fashion to the problems associated with smoking, discovered in the 1970's and the role scientific research should play in influencing policy formulation. The work focuses on the role the scientific community requires to play to either prove or dispel (strong scientific facts) fears about the health effects of mobile telephony.

Mobile telephony is now commonplace around the world. This wireless technology relies upon an extensive network of fixed antennas, or base stations, relaying information with radiofrequency (RF) signals. Over 1.4 million base stations exist worldwide and the number is increasing significantly with the introduction of third generation technology or 3G.

There has been concern about possible health consequences from exposure to the RF fields produced by wireless technologies. Mobile phone radiation and health concerns have been raised, especially following the enormous increase in the use of wireless mobile telephony throughout the world (as of August 2005, there were more than 2 billion users worldwide). Mobile phones use electromagnetic radiation in the microwave range, and some feel this may be harmful to human health. These concerns have induced a large body of research (both epidemiological and experimental, in non-human animals as well as in humans). Concerns about effects on health have also been raised regarding other digital wireless systems, such as data communication networks.

A mobile phone is a low-powered two-way radio, converting human voice and data messages into radio waves. When making a call, the radio signals are transmitted from the mobile phone to the nearest base station. Once a signal reaches a base station it is then transmitted to the main telephone network where it is transferred to the network of the person receiving the call.

Mobile phones operate on a system of cells, each cell supported by a radio base station, which is a facility that provides transmission and reception for radio systems. Each mobile phone operator divides a country into thousands of individual geographic areas or 'cells'. The cells overlap at the edges to prevent holes in coverage. There are three types of cell: macrocells which provide the main structure for the base station network with a range of up to 35 kilometres; microcells which infill and improve the main network, with a range of up to a few hundred metres; and picocells which have a much smaller range and are used in busy areas such as inside buildings, airports and shopping centres. The systems are demand-led, and to achieve coverage, each cell has to be provided with a base station, which hands the calls over from one area to another. If they are too far apart, calls are interrupted or dropped when mobile phone users are on the move. Increased usage of mobile phones also results in a higher demand for base stations, as each has a limited capacity, and this can be expanded by the addition of more base stations within macrocells or microcells.

Radio base stations are commonly called masts, and although the terms are used interchangeably, they are in fact two different things**.** Radio base stations are sites that enable mobile phones to work. They can be big or small, and always have transmitters or receivers in a cabin or cabinet connected to antennas nearby. A base station (i.e. transmitters, receivers and antennas) can be mounted on a large mast or tower, on existing buildings, rooftops or in street furniture. Strictly speaking, a mast is the freestanding structure which supports antennas at a height where they can transmit and receive radio waves. A mast is typically 15m high and plays no part in itself in the transmission of radio waves.

The cells in a new third generation (3G) network are smaller because 3G uses a higher radio frequency. These cells also expand and contract in size depending on the number of simultaneous calls being made. For this reason, 3G cells will have to overlap more than the current 2G cells, and although it is anticipated that operators will be able to re-use some of their existing infrastructure, they will also need to develop a substantial number of new sites.

For years the cell phone companies have assured the public that cell phones are perfectly safe. They state that the particular set of radiation parameters associated with cell phones are the same as any other radio signal. However, reported scientific evidence challenges this view and shows that cell phone radiation causes various effects, including:

– Altering brain activity

– Sleep disturbance

– Alteration of human reaction times: responses and speed of switching attention significantly worse

– Weakness of the blood brain barrier

– Increased auditory brainstem response and hearing deficiency in 2 KHZ to 10 KHZ range

–Significant changes in local temperature, and in physiologic parameters of the cardiovascular system

– Memory loss, connection difficulties, fatigue, and headaches

– Increased blood pressure

– Reduction melatonin, etc..

According to Cherry (2000), there is strong evidence to conclude that cell sites are risk factors for:

– Cancer, specifically brain tumours and leukaemia

– Heart attack and heart disease, particularly arrhythmia

– Neurological effects including sleep disturbance, learning difficulties, depression and suicide

– Reproductive effects, especially miscarriage and congenital malformation

– Viral and infectious diseases because of reduced immune system competency associated with reduced melatonin and altered calcium ion homeostasis.

The World Health Organization, however, “based upon the consensus view of the scientific and medical communities”, states that health effects (e.g. headaches) are unlikely to be caused by cellular phones or their base stations. However, some national radiation advisory authorities, including those of Austria, France, Germany, and Sweden recommended to their citizens measures to minimize exposure.

Often it seems that studies are conducted on political grounds, rather than scientific grounds. Government and the Telecommunication Industry would prefer citizens to read and hear about their scientists’ ‘research’, for example - but with their huge financial gains reliant on ‘safe results’ can you blame anyone for being skeptical about how trustworthy their research actually is? Therefore, a coordinated research strategy, preferably without necessarily seeking Government endorsement, using a multidisciplinary approach would seem to be a practical way forward. In particular, more coordination of molecular and other approaches in both animal and human research.

People living close to mobile phone masts (base stations) frequently report symptoms of electromagnetic hypersensitivity such as dizziness, headaches, skin conditions, allergies and many others, the mechanisms for which are only just beginning to be understood. There is also growing anecdotal evidence for cancer clusters forming around them. However, we are regularly told by the mobile phone industry that these base stations are safe because their microwave radiation falls off rapidly with distance and is far too low to generate significant heat. Sadly, this is not true. It is based on the false assumption that it is only their heating effect that can cause damage and a serious misunderstanding of the ways in which living organisms use negative feedback to respond to changes in their environment, including the metabolic insults from mobile phones.

There are hundreds of scientific papers in peer-reviewed scientific journals showing biological effects from non-ionising radiation that may be hundreds or thousands of times below the levels that cause significant heating. Furthermore, these non-thermal effects include many independent and well-replicated studies showing that the radiation from mobile phone handsets can cause serious damage to the DNA of living cells in less than 24 hours, so we cannot regard these handsets as being safe for anything other than short-term use.

Because of the extreme sensitivity of at least some cells to mobile phone radiation, it is likely that the much weaker radiation reaching people living or working close to base stations will also suffer adverse effects. Claims by the mobile phone industry that the base stations are safe because the radiation falls off rapidly with distance are flawed. Although the radiation level does indeed fall off as they say, the biological response will remain more or less constant over a wide range of signal strengths due to the ways in which living cells routinely use 'negative feedback' to compensate for changes in their environment.

Living cells have a range of negative feedback mechanisms that sense non-thermal radiation damage and use it to trigger various defence systems. These systems are expensive in energy and resources and also reduce metabolic efficiency. The object therefore has to be to keep this damage within 'tolerable' limits rather than to eliminate it. They do this by cutting in only when they approach the limits of toleration. The effect is to keep the damage at or close to these 'trigger points' over a wide range of radiation levels, ranging from that due to a mobile phone handset held close to the head, to that from a mast, which may be hundreds of metres away.

The radiation from a handset may actually be less damaging since it is used only intermittently and the body has a chance to recover in between times. However, continuous irradiation from mobile phone base stations, DECT phone base stations and Wi-Fi routers may not allow adequate recovery time, so chronic irradiation from these sources could be far more damaging and more likely to result in cancer, allergy-related conditions and electromagnetic hypersensitivity. There is an urgent need for further research in this area, since the assumption that the only biological effects of non-ionising radiation are due to heating, and fall off rapidly with distance, no longer fits the facts.

The concept of negative feedback is extremely simple. For example, if your house is too hot you turn the heating down. This not only makes you feel more comfortable, it also saves fuel. You may regulate the heating manually or you might have a thermostat that does it for you by cutting off the heat when the temperature reaches a predetermined value. In either case, the effect is the same; whenever the temperature isn't right, the thermostat tries to correct it by making the heating system respond in the opposite direction; this is termed negative feedback. Negative feedback is also very familiar to engineers in the electronics industries where it has countless applications. A simple example is the automatic gain control in some radios. This feeds some of the signal going to the loudspeaker back to the amplifier section so that if it is too loud it turns down the gain to keep the sound volume more or less constant over a wide range of signal strengths. As you will soon see, this is very relevant to the way in which the different signal strengths from mobile phones and their base stations can give very similar biological responses.

Living organisms are full of negative feedback systems, where they are essential to their normal function and ability to respond to an ever-changing environment. For example, if your body finds that it has too much of a particular biochemical, it may turn down or turn off the activity of the enzyme system that makes it. This not only keeps other systems that depend on this chemical running smoothly, it also stops the body wasting resources by making a substance that it doesn't need.

So how does this form of biological feedback relate to mobile phones and their masts? Put very simply, because of the extreme sensitivity of at least some living cells to weak non-ionising radiation , the question is not why the weak radiation from a distant mast does so much damage, it is why a handset next to the ear doesn't do very much more.

The answer lies in our own negative feedback systems. The body is well able to detect the radiation and the resulting damage. It then puts into action a range of negative feedback meas-

ures to mitigate the effects. One of the most damaging effects of this form of radiation is the loss of some of the calcium that normally strengthens cell membranes. This results in an increased leakage of materials through cell membranes that can affect many aspects of metabolism. These include damage to DNA, from digestive enzymes leaking from lysosomes (tiny membrane-bound structures in living cells that normally recycle waste), apoptosis (cell death), the generation of false nerve impulses from calcium leakage in brain cells (causing hyperactivity, impairing normal mental function and generating many of the known symptoms of electromagnetic hypersensitivity.

Views on the effects of mobile phone base stations are so polarsied with a significant number of scientific papers in peer-reviewed scientific journals showing no significant biological effects from non-ionising radiation yet other reported scientific evidence challenges this view and shows that cell phone and base station radiation causes various effects, including headache, cancer and increased blood pressure.

Elaine Fox of the Electromagnetics & Health Laboratory at the University of Essex in the UK, in a study on *Health Effects of Mobile Phone Base-stations*, concludes that: "In my view, there is a genuine uncertainty regarding the non-thermal effects of mobile phones & their associated base-stations. We need more well-designed studies to assess biological mechanisms in a more focused way."

Research designed to examine the perceptions of phone users, policy makers and importantly, people who live near mobile telephone base stations on the effects of these transceivers on human health and the environment found that a significant number (mostly the educated) of phone users appreciate the fact mobile phone usage and its associated technologies could have adverse effects on their health. This study which in effect should influence policy formulation and drive further studies and research into effects on health and the environment of mobile phone base stations, found that phone company executives are reluctant to discuss effects of mobile phone masts or any scientific research into the effects of RF-EMFs. Results of the research should also shape the direction, form and methodology of any further research in the field of effects of Radio frequency – Electromagnetic Frequencies (RF-EMFs) on human health and the environment. By discretely, interviewing and interacting with telecommunications technicians and regulators, the research examined issues pertaining to occupational health hazards and safety standards. The revelations are staggering. Telecom technicians who service masts believe occupational health standards are followed by employers, fearing not to scare away technical staff they heavily depend on for keeping networks running.

An increase in the number of mobile users and the emergence of new in the telecom arena, translates into the construction of more masts but what is the perception of policy makers and the communities that live near these masts on their effects on health and the environment? Are they aware of the dangers associated with living near Electromagnetic Frequencies emitting antennas? Are policy makers and regulators aware of fears in some countries that living near base stations may cause conditions like memory loss, connection difficulties, fatigue, and headaches brain tumors and leukaemia. Have regulators considered recommending mast sharing for the different telecom companies? And what would be the motivation of taking such a step? Are telecom companies taking advantage of increasing fact that trendy mobile phones are a becoming a fashion at the expense of health? Are we back to the seventies when smoking a cigarette was highly fashionable?

Scientific research played a massive role in proving a link between smoking and cancer, something the scientific community is struggling to do with *the handset* and its associated technologies. Studies examining the effects of Radio frequency – Electromagnetic Frequencies (RF-EMFs) on human health have not reported EMF exposure in a clear way. And more importantly, despite the fact that national radiation advisory authorities, including those of Austria, France, Germany, and Sweden recommended to their citizens measures to minimize exposure, no such recommendations or caution has been echoed by the Ugandan Government, for example. Neither has there been a study to experimentally examine the effects of mobile phones or base stations on health.

Apparently, the ball is now in the scientists' hands to repeat history by creating a smooth line between mobile telephony and health since there is widespread public concern about the potential adverse health effects of mobile phones, and especially their associated base-stations. Could this lead us into a wider investigation of effects of the same frequencies on bees? And how would known effects affect food production? Results of the research should reveal the existence or absence of symptoms or conditions that have been linked to living in close proximity to mobile phone base stations.

Conclusively, with the mobile companies accounting for about 20% (and Nokia contributing more than 45% in Finland) of national earnings and this being a very contested research area, scientific research is required to effectively explore all possible side effects of mobile phone usage as telecoms take advantage of the young generation that considers trendy and the latest phone gadgetry a fashion.