ETIOLOGY OF THE DISEASES CAUSED BY BACTERIUM ESCHERICHIA COLI ACCORDING TO AN ELECTROMAGNETIC MODE

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Abstract: *There are evidences according to which the colonies of Escherichia coli bacterium form parabolic cylindrical structures. In such circumstances many symptoms are generated which are produced by a parasitic capacitance. This last is generated by the bacteria and it was calculated using a mathematical model using computer algebra. The mathematical model was built using Laplace equation, Whittaker functions, Hermite functions and the corresponding boundary condition. The resulting mathematical model was implemented using a maple algorithm. This algorithm can be extended to other kinds of bacteria whose colonies are characterized by different classes of specific geometries. Our results suggest that the antibodies are not able to find the bacteria because the induced parasitic capacitance alters the electromagnetic signals that the brain sends to the immune system doing that antibodies lost the signals that are indentifying those colonies.*

Keywords: *parabolic cylinder, parasitic capacitance, computer algebra, E-Coli, Laplace equation, Whittaker functions, Hermite functions.*

1 Introduction

The bacterium Escherichia coli or better known as E-coli through the history has been the bacteria most studied around the world because this is the principal cause of the gastrointestinal diseases in humans. The colonies of these bacteria form in some circumstances parabolic cylindrical structures creating a parasitic capacitive [1] effect due to electric potential that each bacterium contain and for hence due to the electric potential that all structure contains, as will be see later. This parasitic capacitance changes the electrostatic potential of the intestine, causing the gastro intestinal symptoms and altering the control of the electromagnetic signals that are regulating the immune system.

In this work will obtain a mathematical expression that defines the etiology of the diseases caused by bacterium Escherichia coli in terms of a parasitic capacitance and with this aim we will derive the electric potential and de electric field using especial functions such as Hermit function and Whittaker function. All computation will be made using Maple.

2. Problem

After decades of study in biology have resulted evidence of the structure that form the Escherichia Coli colonies. Some colonies have particular forms that create symptoms on the humans and the animals for this reason is justified study them with computational math.

In figure 1 and figure 2 are shown particular forms of Escherichia coli colonies that will be studied in this work with the objet to obtain physical explanations of their effects on humans and animals. The images in figures 1 and 2 were obtained by scanning electron microscopy.

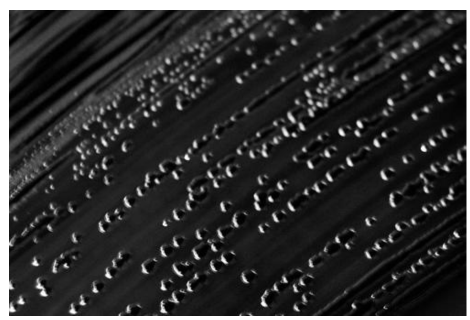


Figure 1, Photography of Escherichia-Coli

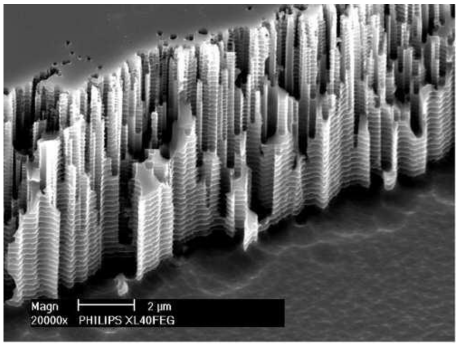


Figure 2, Photography of Escherichia-Coli with SEM (Scanning Electron Microscope).

Idealizing a little bit, we can represent a colony of the bacteria E-coli by a set of parabolic cylinders that create an effect of parasitic capacitance, as is illustrator en figure 3.

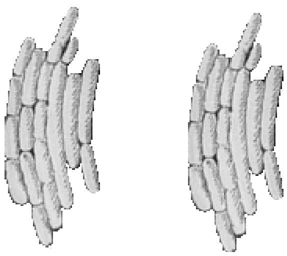


Figure 3, parabolic cylinder formed for E-coli bacteria.

As each bacterium contains a small amount of electric charge then the resulting parabolic cylinder formed by the colony will have an electric potential and this potential will be called V (α, β, z) as shown in Figure 4.

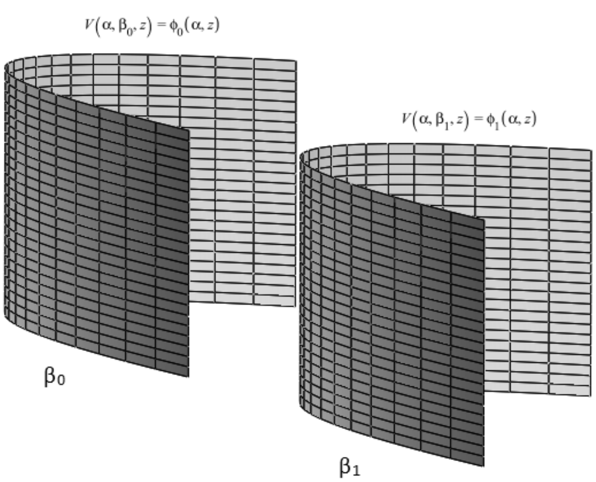


Figure 3, idealized model of tow parabolic cylinders made by E-coli bacteria

The equation that will use to determine the electrical potential between the parabolic cylinders is the Laplace equation, which in cartesian coordinates is described as:

$$\frac{\partial^2}{\partial x^2} V(x,y,z) + \frac{\partial^2}{\partial y^2} V(x,y,z) + \frac{\partial^2}{\partial z^2} V(x,y,z) = 0$$

For practical purposes the Laplace equation will be worked in parabolic cylindrical coordinates defined by [2]:

$$x = \frac{1}{2}\alpha^2 - \frac{1}{2}\beta^2\,, \qquad y = \alpha\beta, \qquad z = z$$

Where $\alpha \in [0,\infty)$, $\beta \in [0,\infty)$, and $z \in (-\infty,\infty)$.

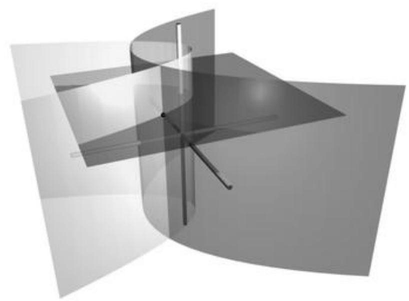


Figure 4. Coordinate surfaces of parabolic cylindrical coordinates.

Rewriting the Laplace equation in parabolic cylindrical coordinates we obtain:

$$\frac{1}{\alpha^2+\beta^2}\left(\frac{\partial^2}{\partial\alpha^2} V(\alpha,\beta,z) + \frac{\partial^2}{\partial\beta^2} V(\alpha,\beta,z) + \left(\alpha^2+\beta^2\right)\left(\frac{\partial^2}{\partial z^2} V(\alpha,\beta,z)\right)\right) = 0$$

To find the solution to the problem is required to establish boundary conditions. In our case we use Dirichlet conditions which consist in specify the solution *V (α,β,z)* on the border of the application domain of the Laplace equation. In our case the borders that delimit such domain are two parabolic cylindrical surfaces determined as $\beta=\beta_0$ y $\beta=\beta_1$ giving that we only take into account the potential generated between these two surfaces.

$$V(\alpha, \beta_0, z) = \phi_0(\alpha, z)$$

$$V(\alpha, \beta_1, z) = \phi_1(\alpha, z)$$

3 Method

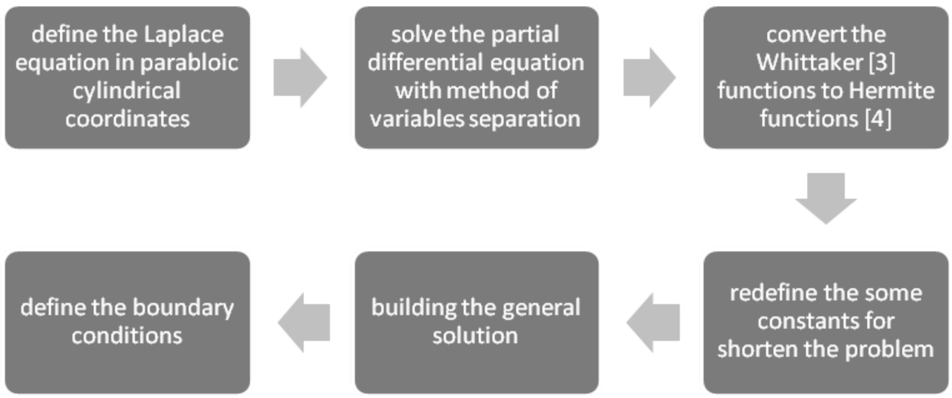
To solve the problem we used computer algebra, specifically Maple and with its help packages including "VectorCalculus" and "PDETools”.

for reasons of space was not possible to show all the algorithm is illustrated for this reason the procedure took place in the following flow chart but if you want you can download it copy the following URL in your web browser

http://dl.dropbox.com/u/7791924/ETIOLOGY%20OF%20THE%20DISEASES%20CAUSED%20BY%20BACTERIUM%20ESCHERICHIA%20COLI%20ACCORDING%20TO%20AN%20ELECTROMAGNETIC%20MODE.mw

or

http://cid-ad28443fd7d93b36.office.live.com/self.aspx/P%c3%bablico/ETIOLOGY%20OF%20THE%20DISEASES%20CAUSED%20BY%20BACTERIUM%20ESCHERICHIA%20COLI%20ACCORDING%20TO%20AN%20ELECTROMAGNETIC%20MODE.mw



4 Results

$$\phi_0(\alpha, z) = \int_{-\infty}^{\infty} \phi_0(\alpha, \lambda)\cos(\lambda z)\,d\lambda \qquad \phi_1(\alpha, z) = \int_{-\infty}^{\infty} \phi_1(\alpha, \lambda)\cos(\lambda z)\,d\lambda$$

$$V(\alpha,\beta,z) = \int_{-\infty}^{\infty} \left(\sum_{n=0}^{\infty} e^{-\frac{1}{2}\lambda\alpha^2} \cos(\lambda z)\, \mathrm{HermiteH}(n, \sqrt{\lambda}\,\alpha) \left(\left(\sqrt{\beta_0}\sqrt{\lambda}\sqrt{\beta_1} \left(-\mathrm{HermiteH}(-n-1, \sqrt{\lambda}\,\beta_0)\, e^{-\frac{1}{2}\lambda\beta_0^2} \left(\int_{-\infty}^{\infty} \frac{\mathrm{HermiteH}(n,x)\, e^{-\frac{1}{2}x^2}\phi_1(x,\lambda)}{\sqrt{\lambda}}\,dx \right) + \left(\int_{-\infty}^{\infty} \frac{e^{-\frac{1}{2}x^2}\,\mathrm{HermiteH}(n,x)\,\phi_0(x,\lambda)}{\sqrt{\lambda}}\,dx \right) \mathrm{HermiteH}(-n-1, \sqrt{\lambda}\,\beta_1)\, e^{-\frac{1}{2}\lambda\beta_1^2} \right) \mathrm{WhittakerM}\left(-\frac{1}{2}n - \frac{1}{4}, \frac{1}{4}, \lambda\beta^2\right) \right) \Big/ \left(\sqrt{\beta}\, n!\, 2^n \sqrt{\pi} \left(-\mathrm{HermiteH}(-n-1, \sqrt{\lambda}\,\beta_0)\, e^{-\frac{1}{2}\lambda\beta_0^2} \sqrt{\beta_0}\, \mathrm{WhittakerM}\left(-\frac{1}{2}n - \frac{1}{4}, \frac{1}{4}, \lambda\beta_1^2\right) + \mathrm{HermiteH}(-n-1, \sqrt{\lambda}\,\beta_1)\, e^{-\frac{1}{2}\lambda\beta_1^2} \sqrt{\beta_1}\, \mathrm{WhittakerM}\left(-\frac{1}{2}n - \frac{1}{4}, \frac{1}{4}, \lambda\beta_0^2\right) \right) \right) + \left(\mathrm{HermiteH}(-n-1, \sqrt{\lambda}\,\beta)\, e^{-\frac{1}{2}\lambda\beta^2} \sqrt{\lambda} \left(-\left(\int_{-\infty}^{\infty} \frac{e^{-\frac{1}{2}x^2}\,\mathrm{HermiteH}(n,x)\,\phi_0(x,\lambda)}{\sqrt{\lambda}}\,dx \right) \sqrt{\beta_0}\, \mathrm{WhittakerM}\left(-\frac{1}{2}n - \frac{1}{4}, \frac{1}{4}, \lambda\beta_1^2\right) + \left(\int_{-\infty}^{\infty} \frac{\mathrm{HermiteH}(n,x)\, e^{-\frac{1}{2}x^2}\phi_1(x,\lambda)}{\sqrt{\lambda}}\,dx \right) \sqrt{\beta_1}\, \mathrm{WhittakerM}\left(-\frac{1}{2}n - \frac{1}{4}, \frac{1}{4}, \lambda\beta_0^2\right) \right) \right) \Big/ \left(n!\, 2^n \sqrt{\pi} \left(-\mathrm{HermiteH}(-n-1, \sqrt{\lambda}\,\beta_0)\, e^{-\frac{1}{2}\lambda\beta_0^2} \sqrt{\beta_0}\, \mathrm{WhittakerM}\left(-\frac{1}{2}n - \frac{1}{4}, \frac{1}{4}, \lambda\beta_1^2\right) + \mathrm{HermiteH}(-n-1, \sqrt{\lambda}\,\beta_1)\, e^{-\frac{1}{2}\lambda\beta_1^2} \sqrt{\beta_1}\, \mathrm{WhittakerM}\left(-\frac{1}{2}n - \frac{1}{4}, \frac{1}{4}, \lambda\beta_0^2\right) \right) \right) \right) d\lambda$$

4.1 Electric field

$$E(\alpha,\beta,z) = -\frac{1}{\sqrt{\alpha^2+\beta^2}} \Bigg(\int_{-\infty}^{\infty} \Bigg(\sum_{n=0}^{\infty} - \Bigg(\Bigg(\Bigg(\sqrt{\beta_0}\,\sqrt{\beta_1}\,\mathrm{WhittakerM}\Big(-\frac{1}{2}n-\frac{1}{4}, \frac{1}{4}, \lambda\beta^2\Big)\,\mathrm{HermiteH}\big(-n-1, \sqrt{\lambda}\,\beta_0\big)\,e^{-\frac{1}{2}\lambda\beta_0^2} \Bigg($$

$$\int_{-\infty}^{\infty} \frac{e^{-\frac{1}{2}x^2}\,\mathrm{HermiteH}(n,x)\,\phi_1(x,\lambda)}{\sqrt{\lambda}}\,dx \Bigg) - \sqrt{\beta_0}\,\sqrt{\beta_1}\,\mathrm{WhittakerM}\Big(-\frac{1}{2}n-\frac{1}{4}, \frac{1}{4}, \lambda\beta^2\Big) \Bigg(\Bigg(\int_{-\infty}^{\infty} \frac{e^{-\frac{1}{2}x^2}\,\mathrm{HermiteH}(n,x)\,\phi_0(x,\lambda)}{\sqrt{\lambda}}\,dx \Bigg)$$

$$\mathrm{HermiteH}\big(-n-1, \sqrt{\lambda}\,\beta_1\big)\,e^{-\frac{1}{2}\lambda\beta_1^2} + \mathrm{HermiteH}\big(-n-1, \sqrt{\lambda}\,\beta\big)\,e^{-\frac{1}{2}\lambda\beta^2}\sqrt{\beta} \Bigg(\int_{-\infty}^{\infty} \frac{e^{-\frac{1}{2}x^2}\,\mathrm{HermiteH}(n,x)\,\phi_0(x,\lambda)}{\sqrt{\lambda}}\,dx \Bigg)$$

$$\sqrt{\beta_0}\,\mathrm{WhittakerM}\Big(-\frac{1}{2}n-\frac{1}{4}, \frac{1}{4}, \lambda\beta_1^2\Big) - \mathrm{HermiteH}\big(-n-1, \sqrt{\lambda}\,\beta\big)\,e^{-\frac{1}{2}\lambda\beta^2}\sqrt{\beta} \Bigg(\int_{-\infty}^{\infty} \frac{e^{-\frac{1}{2}x^2}\,\mathrm{HermiteH}(n,x)\,\phi_1(x,\lambda)}{\sqrt{\lambda}}\,dx \Bigg)$$

$$\sqrt{\beta_1}\,\mathrm{WhittakerM}\Big(-\frac{1}{2}n-\frac{1}{4}, \frac{1}{4}, \lambda\beta_0^2\Big) \Bigg) \Big(\lambda\,\alpha\,\mathrm{HermiteH}\big(n, \sqrt{\lambda}\,\alpha\big) - 2\sqrt{\lambda}\,n\,\mathrm{HermiteH}\big(n-1, \sqrt{\lambda}\,\alpha\big)\Big)\,e^{-\frac{1}{2}\lambda\alpha^2}\cos(\lambda z)\sqrt{\lambda}\,2^{-n}\Big) \Bigg/$$

$$\Bigg(\sqrt{\beta}\,\Bigg(\mathrm{HermiteH}\big(-n-1, \sqrt{\lambda}\,\beta_0\big)\,e^{-\frac{1}{2}\lambda\beta_0^2}\sqrt{\beta_0}\,\mathrm{WhittakerM}\Big(-\frac{1}{2}n-\frac{1}{4}, \frac{1}{4}, \lambda\beta_1^2\Big) - \mathrm{HermiteH}\big(-n-1, \sqrt{\lambda}\,\beta_1\big)\,e^{-\frac{1}{2}\lambda\beta_1^2}\sqrt{\beta_1}$$

$$\mathrm{WhittakerM}\Big(-\frac{1}{2}n-\frac{1}{4}, \frac{1}{4}, \lambda\beta_0^2\Big)\Bigg)\sqrt{\pi}\,n!\Bigg)\Bigg)\,d\lambda\Bigg)e_\alpha - \frac{1}{\sqrt{\alpha^2+\beta^2}} \Bigg(\int_{-\infty}^{\infty} \Bigg(\sum_{n=0}^{\infty} - \Bigg(e^{-\frac{1}{2}\lambda\alpha^2}\cos(\lambda z)\,\mathrm{HermiteH}\big(n,$$

$$\sqrt{\lambda}\,\alpha\big) \Bigg(\sqrt{\beta_0}\,\lambda^{3/2}\sqrt{\beta_1}\,\mathrm{WhittakerM}\Big(-\frac{1}{2}n-\frac{1}{4}, \frac{1}{4}, \lambda\beta^2\Big)\beta^2\,\mathrm{HermiteH}\big(-n-1, \sqrt{\lambda}\,\beta_0\big)\,e^{-\frac{1}{2}\lambda\beta_0^2} \Bigg($$

$$\int_{-\infty}^{\infty} \frac{e^{-\frac{1}{2}x^2}\,\mathrm{HermiteH}(n,x)\,\phi_1(x,\lambda)}{\sqrt{\lambda}}\,dx \Bigg) + \sqrt{\beta_0}\,\sqrt{\lambda}\,\sqrt{\beta_1}\,\mathrm{HermiteH}\big(-n-1, \sqrt{\lambda}\,\beta_0\big)\,e^{-\frac{1}{2}\lambda\beta_0^2} \Bigg(\int_{-\infty}^{\infty} \frac{e^{-\frac{1}{2}x^2}\,\mathrm{HermiteH}(n,x)\,\phi_1(x,\lambda)}{\sqrt{\lambda}}\,dx \Bigg)$$

$$\mathrm{WhittakerM}\Big(-\frac{1}{2}n-\frac{1}{4}, \frac{1}{4}, \lambda\beta^2\Big)n + \sqrt{\beta_0}\,\sqrt{\lambda}\,\sqrt{\beta_1}\,\mathrm{HermiteH}\big(-n-1, \sqrt{\lambda}\,\beta_0\big)\,e^{-\frac{1}{2}\lambda\beta_0^2} \Bigg($$

$$\int_{-\infty}^{\infty} \frac{e^{-\frac{1}{2}x^2}\,\mathrm{HermiteH}(n,x)\,\phi_1(x,\lambda)}{\sqrt{\lambda}}\,dx \Bigg)\mathrm{WhittakerM}\Big(-\frac{1}{2}n+\frac{3}{4}, \frac{1}{4}, \lambda\beta^2\Big) - \sqrt{\beta_0}\,\sqrt{\lambda}\,\sqrt{\beta_1}\,\mathrm{HermiteH}\big(-n-1, \sqrt{\lambda}\,\beta_0\big)\,e^{-\frac{1}{2}\lambda\beta_0^2} \Bigg($$

$$\int_{-\infty}^{\infty} \frac{e^{-\frac{1}{2}x^2}\,\mathrm{HermiteH}(n,x)\,\phi_1(x,\lambda)}{\sqrt{\lambda}}\,dx \Bigg)\mathrm{WhittakerM}\Big(-\frac{1}{2}n+\frac{3}{4}, \frac{1}{4}, \lambda\beta^2\Big)n - \sqrt{\beta_0}\,\lambda^{3/2}\sqrt{\beta_1}\,\mathrm{WhittakerM}\Big(-\frac{1}{2}n-\frac{1}{4}, \frac{1}{4}, \lambda\beta^2\Big)\beta^2 \Bigg($$

$$\int_{-\infty}^{\infty} \frac{e^{-\frac{1}{2}x^2}\,\mathrm{HermiteH}(n,x)\,\phi_0(x,\lambda)}{\sqrt{\lambda}}\,dx \Bigg)\mathrm{HermiteH}\big(-n-1, \sqrt{\lambda}\,\beta_1\big)\,e^{-\frac{1}{2}\lambda\beta_1^2} - \sqrt{\beta_0}\,\sqrt{\lambda}\,\sqrt{\beta_1} \Bigg(\int_{-\infty}^{\infty} \frac{e^{-\frac{1}{2}x^2}\,\mathrm{HermiteH}(n,x)\,\phi_0(x,\lambda)}{\sqrt{\lambda}}\,dx \Bigg)$$

$$\mathrm{HermiteH}\big(-n-1, \sqrt{\lambda}\,\beta_1\big)\,e^{-\frac{1}{2}\lambda\beta_1^2}\,\mathrm{WhittakerM}\Big(-\frac{1}{2}n-\frac{1}{4}, \frac{1}{4}, \lambda\beta^2\Big)n - \sqrt{\beta_0}\,\sqrt{\lambda}\,\sqrt{\beta_1} \Bigg(\int_{-\infty}^{\infty} \frac{e^{-\frac{1}{2}x^2}\,\mathrm{HermiteH}(n,x)\,\phi_0(x,\lambda)}{\sqrt{\lambda}}\,dx \Bigg)$$

$$\mathrm{HermiteH}\big(-n-1, \sqrt{\lambda}\,\beta_1\big)\,e^{-\frac{1}{2}\lambda\beta_1^2}\,\mathrm{WhittakerM}\Big(-\frac{1}{2}n+\frac{3}{4}, \frac{1}{4}, \lambda\beta^2\Big) + \sqrt{\beta_0}\,\sqrt{\lambda}\,\sqrt{\beta_1} \Bigg(\int_{-\infty}^{\infty} \frac{e^{-\frac{1}{2}x^2}\,\mathrm{HermiteH}(n,x)\,\phi_0(x,\lambda)}{\sqrt{\lambda}}$$

$$\mathrm{d}x \Big) \mathrm{HermiteH}(-n-1, \sqrt{\lambda}\, \beta_1)\, e^{-\frac{1}{2}\lambda \beta_1^2}\, \mathrm{WhittakerM}(-\tfrac{1}{2} n + \tfrac{3}{4}, \tfrac{1}{4}, \lambda \beta^2)\, n - 2\lambda\, \mathrm{HermiteH}(-n-2, \sqrt{\lambda}\, \beta)\, e^{-\frac{1}{2}\lambda \beta^2} \beta^{3/2}$$

$$\Big(\Big(\int_{-\infty}^{\infty} \frac{e^{-\frac{1}{2}x^2}\, \mathrm{HermiteH}(n, x)\, \phi_0(x, \lambda)}{\sqrt{\lambda}}\, \mathrm{d}x \Big) \sqrt{\beta_0}\, \mathrm{WhittakerM}(-\tfrac{1}{2} n - \tfrac{1}{4}, \tfrac{1}{4}, \lambda \beta_1^2) + 2\lambda\, \mathrm{HermiteH}(-n-2, \sqrt{\lambda}\, \beta)\, e^{-\frac{1}{2}\lambda \beta^2} \beta^{3/2} \Big($$

$$\int_{-\infty}^{\infty} \frac{e^{-\frac{1}{2}x^2}\, \mathrm{HermiteH}(n, x)\, \phi_1(x, \lambda)}{\sqrt{\lambda}}\, \mathrm{d}x \Big) \sqrt{\beta_1}\, \mathrm{WhittakerM}(-\tfrac{1}{2} n - \tfrac{1}{4}, \tfrac{1}{4}, \lambda \beta_0^2) - 2\lambda\, \mathrm{HermiteH}(-n-2, \sqrt{\lambda}\, \beta)\, e^{-\frac{1}{2}\lambda \beta^2} \beta^{3/2} n \Big($$

$$\int_{-\infty}^{\infty} \frac{e^{-\frac{1}{2}x^2}\, \mathrm{HermiteH}(n, x)\, \phi_0(x, \lambda)}{\sqrt{\lambda}}\, \mathrm{d}x \Big) \sqrt{\beta_0}\, \mathrm{WhittakerM}(-\tfrac{1}{2} n - \tfrac{1}{4}, \tfrac{1}{4}, \lambda \beta_1^2) + 2\lambda\, \mathrm{HermiteH}(-n-2, \sqrt{\lambda}\, \beta)\, e^{-\frac{1}{2}\lambda \beta^2} \beta^{3/2} n \Big($$

$$\int_{-\infty}^{\infty} \frac{e^{-\frac{1}{2}x^2}\, \mathrm{HermiteH}(n, x)\, \phi_1(x, \lambda)}{\sqrt{\lambda}}\, \mathrm{d}x \Big) \sqrt{\beta_1}\, \mathrm{WhittakerM}(-\tfrac{1}{2} n - \tfrac{1}{4}, \tfrac{1}{4}, \lambda \beta_0^2) - \mathrm{HermiteH}(-n-1, \sqrt{\lambda}\, \beta)\, \lambda^{3/2} \beta^{5/2} e^{-\frac{1}{2}\lambda \beta^2} \Big($$

$$\int_{-\infty}^{\infty} \frac{e^{-\frac{1}{2}x^2}\, \mathrm{HermiteH}(n, x)\, \phi_0(x, \lambda)}{\sqrt{\lambda}}\, \mathrm{d}x \Big) \sqrt{\beta_0}\, \mathrm{WhittakerM}(-\tfrac{1}{2} n - \tfrac{1}{4}, \tfrac{1}{4}, \lambda \beta_1^2) + \mathrm{HermiteH}(-n-1, \sqrt{\lambda}\, \beta)\, \lambda^{3/2} \beta^{5/2} e^{-\frac{1}{2}\lambda \beta^2} \Big($$

$$\int_{-\infty}^{\infty} \frac{e^{-\frac{1}{2}x^2}\, \mathrm{HermiteH}(n, x)\, \phi_1(x, \lambda)}{\sqrt{\lambda}}\, \mathrm{d}x \Big) \sqrt{\beta_1}\, \mathrm{WhittakerM}(-\tfrac{1}{2} n - \tfrac{1}{4}, \tfrac{1}{4}, \lambda \beta_0^2) \Big) 2^{-n} \Big) \Big) \Big/ \Big(\beta^{3/2} \Big(-\mathrm{HermiteH}(-n-1,$$

$$\sqrt{\lambda}\, \beta_0)\, e^{-\frac{1}{2}\lambda \beta_0^2} \sqrt{\beta_0}\, \mathrm{WhittakerM}(-\tfrac{1}{2} n - \tfrac{1}{4}, \tfrac{1}{4}, \lambda \beta_1^2) + \mathrm{HermiteH}(-n-1, \sqrt{\lambda}\, \beta_1)\, e^{-\frac{1}{2}\lambda \beta_1^2} \sqrt{\beta_1}\, \mathrm{WhittakerM}($$

$$-\tfrac{1}{2} n - \tfrac{1}{4}, \tfrac{1}{4}, \lambda \beta_0^2) \Big) \sqrt{\pi}\, n! \Big) \Big) \mathrm{d}\lambda \Big) e_\beta - \int_{-\infty}^{\infty} \Big(\sum_{n=0}^{\infty} \Big(- \Big(\Big(\Big(-\sqrt{\beta_0} \sqrt{\beta_1}\, \mathrm{WhittakerM}(-\tfrac{1}{2} n - \tfrac{1}{4}, \tfrac{1}{4}, \lambda \beta^2)\, \mathrm{HermiteH}(-n-1, \sqrt{\lambda}\, \beta_0)$$

$$e^{-\frac{1}{2}\lambda \beta_0^2} \Big(\Big(\int_{-\infty}^{\infty} \frac{e^{-\frac{1}{2}x^2}\, \mathrm{HermiteH}(n, x)\, \phi_1(x, \lambda)}{\sqrt{\lambda}}\, \mathrm{d}x \Big) + \sqrt{\beta_0} \sqrt{\beta_1}\, \mathrm{WhittakerM}(-\tfrac{1}{2} n - \tfrac{1}{4}, \tfrac{1}{4}, \lambda \beta^2) \Big($$

$$\int_{-\infty}^{\infty} \frac{e^{-\frac{1}{2}x^2}\, \mathrm{HermiteH}(n, x)\, \phi_0(x, \lambda)}{\sqrt{\lambda}}\, \mathrm{d}x \Big) \mathrm{HermiteH}(-n-1, \sqrt{\lambda}\, \beta_1)\, e^{-\frac{1}{2}\lambda \beta_1^2} - \mathrm{HermiteH}(-n-1, \sqrt{\lambda}\, \beta)\, e^{-\frac{1}{2}\lambda \beta^2} \sqrt{\beta}$$

$$\Big(\Big(\int_{-\infty}^{\infty} \frac{e^{-\frac{1}{2}x^2}\, \mathrm{HermiteH}(n, x)\, \phi_0(x, \lambda)}{\sqrt{\lambda}}\, \mathrm{d}x \Big) \sqrt{\beta_0}\, \mathrm{WhittakerM}(-\tfrac{1}{2} n - \tfrac{1}{4}, \tfrac{1}{4}, \lambda \beta_1^2) + \mathrm{HermiteH}(-n-1, \sqrt{\lambda}\, \beta)\, e^{-\frac{1}{2}\lambda \beta^2} \sqrt{\beta} \Big($$

$$\int_{-\infty}^{\infty} \frac{e^{-\frac{1}{2}x^2}\, \mathrm{HermiteH}(n, x)\, \phi_1(x, \lambda)}{\sqrt{\lambda}}\, \mathrm{d}x \Big) \sqrt{\beta_1}\, \mathrm{WhittakerM}(-\tfrac{1}{2} n - \tfrac{1}{4}, \tfrac{1}{4}, \lambda \beta_0^2) \Big) e^{-\frac{1}{2}\lambda \alpha^2} \sin(\lambda z)\, \lambda^{3/2}\, \mathrm{HermiteH}(n, \sqrt{\lambda}\, \alpha)\, 2^{-n} \Big) \Big/$$

$$\Big(\sqrt{\beta} \Big(-\mathrm{HermiteH}(-n-1, \sqrt{\lambda}\, \beta_0)\, e^{-\frac{1}{2}\lambda \beta_0^2} \sqrt{\beta_0}\, \mathrm{WhittakerM}(-\tfrac{1}{2} n - \tfrac{1}{4}, \tfrac{1}{4}, \lambda \beta_1^2) + \mathrm{HermiteH}(-n-1, \sqrt{\lambda}\, \beta_1)\, e^{-\frac{1}{2}\lambda \beta_1^2} \sqrt{\beta_1}$$

$$\mathrm{WhittakerM}(-\tfrac{1}{2} n - \tfrac{1}{4}, \tfrac{1}{4}, \lambda \beta_0^2) \Big) \sqrt{\pi}\, n! \Big) \Big) \mathrm{d}\lambda\, e_z$$

Now to find the capacitance we know that:

$$\sigma\Big|_{\beta=\beta_0} = \varepsilon_0 \left(E_\beta\Big|_{\beta=\beta_0} \right)$$

$$dQ\Big|_{\beta=\beta_0} = \sigma\left(\alpha^2+\beta^2\right)\, d\alpha\, dz$$

$$Q\Big|_{\beta=\beta_0} = \int_0^\infty \int_{-\infty}^\infty \varepsilon_0 \left(E_\beta\Big|_{\beta=\beta_0} \right) \left(\alpha^2+\beta_0^2\right) d\alpha\, dz$$

$$C = \frac{Q}{V_1 - V_0}$$

5 Conclusions

In this work was made a study about the Escherichia Coli bacterium for giving a explanation the etymology of this bacterium in electromagnetic terms could be interpreted as follows:

E-Coli bacteria when they enter a human or animal body stays in the intestinal wall forming parabolic cylindrical structures as evidenced in the photographs above. By the fact that those bacteria are alive. These bacteria have a certain amount of electric charge, hence the electric field and electric potential. As in electrical circuits that only the proximity of the components produce a "parasitic capacitance" the Escherichia coli produces the same capacitance produces interference in the order of the electromagnetic signals of the host body such as immune system and gastrointestinal system making antibodies can not easily locate the position of the bacteria in the body and altering the electromagnetic signals of the amino acids that control the gastrointestinal biochemistry.

Software has given an acceleration of the developments that are at the present around the world. In this case Maple allowed developing an algorithm that gives an explanation for the etiology of the E-coli bacterium using electromagnetic concepts which alters the physiology of the beings who suffer from this infection.

Particularly the study was done on E-coli colonies with parabolic cylindrical form but this algorithm can be extended to different bacteria and forms that make their colonies only defining a specific geometry and a coordinate system that helps simplify the problem as much as possible.

6 References

[1] http://en.wikipedia.org/wiki/Parabolic_cylindrical_coordinates

[2] http://en.wikipedia.org/wiki/Parasitic_capacitance

[3] http://mathworld.wolfram.com/WhittakerFunction.html

[4] http://mathworld.wolfram.com/HermitePolynomial.html