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Quantum Model for Information Retrieval in Web 2.0

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Abstract

The study deals with the possibility of information loss in Web 2.0 due to the interaction between the overload and the real information. Using Gottesman and Preskill method, this investigation has proposed a mechanism to calculate the amount of information transformation in Web 2.0. In this proposal, there are three different Hilbert spaces that belong to the degrees of freedom of outside, inside, and overload information of Web 2.0. The information transformation in Web 2.0 is described at two stages. At the first stage, it is shown that the internal stationary state of Web 2.0 can be represented by a maximally entangled two-mode squeezed state of inside and overload information. At the second stage, the state of Web 2.0. is described by a maximally entangled two-mode squeezed state of overload and outside information. The amount of information transformation can be obtained by projecting the state at the first stage on the state at the second stage. Evidently, this study concludes that the information is not lost in Web 2.0.

Keywords: Web 2.0, information loss, Quantum Model, information retrieval

Introduction

Web 2.0 is a term given to describe the second generation of the World Wide Web that is focused on the ability for people to collaborate and share information online, (Tredinnick , 2006). Web 2.0 basically refers to the transition from static HTML Web pages to a more dynamic Web that is more organized and is based on serving Web applications to users, (Anderson, 2007). Other improved functionality of Web 2.0 includes open communication with an emphasis on Web-based communities of users, and more open sharing of information. Over time, Web 2.0 has been used more as a marketing term than a computer-science-based term. Blogs, wikis, and Web services are all seen as components of Web 2.0, (O'Reilly, 2005). The information necessary for the functioning of a given organism is encoded in Web 2.0. Information presentation is a process by which this information is extracted from Web 2.0 in order to introduce systems that carry out specific functions in our life. The expression of Information in Web 2.0 is controlled mainly by entangling and untangling of regulatory information, called overloading information to information inside and outside of Web 2.0. This regulatory information can act as a repressor that decreases the rate of expression of the regulated information (Miller, 2005). The present question is the possibility of information loss in Web 2.0 due to the interaction between the overload and real information. Using Gottesman and Preskill (2004) method, this investigation suggests a mechanism to calculate the amount of information transformation in Web 2.0. In this proposal, there are three different Hilbert spaces that belong to the degrees of freedom of the outside, inside and overload information of Web 2.0. This study defines annihilation and creation operators for the information in each space, and obtains the relation between these operators during transcribing information of inside into outside in Web 2.0. This research derives the entangled state on the outside and inside spaces at the first stage and the entangled state on the inside and overload spaces at the second stage. The amount of information loss is obtained by the projection of the first state onto the second one. The main purpose of this article is to determine different existing Hilbert spaces in operators and the relation between operators and restoring real information in web 2.0. Defining and determining real information using web spaces, this article tries to explain the problem of restoring real information from the unreal ones. The outline of the paper is as follows: In section II, the entangled two-mode squeezed states on the overload and inside Hilbert spaces of Web 2.0 are obtained. Then, the entangled two-mode squeezed states on the outside and overload Hilbert spaces of Web 2.0 are studied in section III. Finally, in section IV, the amount of information loss in Web 2.0 is calculated. The last section is devoted to the summary and conclusion.

Entangled Two-Mode Squeezed States on Overload and Inside Hilbert Spaces of Web 2.0

First, this study wants to consider the entangled state on the overload and inside spaces of Web 2.0 by using Quantum Field Theory. To this end, the present research constructs two Hilbert spaces with a set of operators of creation/annihilation that have the same commutation properties. The total Hilbert space of cell at this stage is the tensor product of the two spaces $H_{\text{web 2.0}} = H_{inside} \otimes H_{overload}$, where in this case H_{inside} and H_{overload} denote the physical quantum states of inside and overload spaces, respectively.

The commutation relations satisfied by the various operators in these spaces are:

$$[\alpha,\alpha^{\dagger}]=1\,,\ [\alpha,\alpha]=0\ ,[b,b^{\dagger}]=1\ \ ,\ [b,b]=0 \tag{1}$$

Where $\alpha,\alpha^{\dagger}$ are annihilation and creation operators that act on the inside space of Web 2.0. respectively. Also $b,b^{\dagger}$ are annihilation and creation operators that act on the overload space of Web 2.0, respectively. The Bogoliubov transformation between these operators can be written as the following equation:

$$c=\cosh(r)\alpha+\sinh(r)b^{\dagger} \tag{2}$$

Where c is an annihilation operator that acts on the Hilbert space of Web 2.0. By using the Bogoliubov transformation, the condition

$$c\left|\text{web 2.0}\right\rangle_{in\otimes overload}=0 \tag{3}$$

Gives rise to the so-called thermal state conditions:

$$\cosh(r)\alpha+\sinh(r)b^{\dagger}\left|web\,2.0\right\rangle_{in\otimes overload}=0 \tag{4}$$

Or equivalently

$$\alpha + \tanh(r) b^{\dagger} \left| web\, 2.0 \right\rangle_{in \otimes overload} = 0 \tag{5}$$

Now, it is assumed that when the information is transcribed from inside into overload, the Web 2.0 state $\left| \text{web } 2.0 \right\rangle_{in\otimes overload}$ is related to the cell vacuum $\left|0\right\rangle$ by

$$\left| web\, 2.0 \right\rangle_{in \otimes overload} = F(\alpha, b^{\dagger}) \left| 0 \right\rangle \tag{6}$$

Where *F* is some function to be determined later.

From $[\alpha, \alpha^{\dagger}] = 1$, we obtain $[\alpha, (\alpha^{\dagger})^m] = \frac{\partial}{\partial \alpha^{\dagger}} (\alpha^{\dagger})^m$ and $[\alpha, F] = \frac{\partial F}{\partial \alpha^{\dagger}}$. Then using equations (5) and (6), we get the following differential equation for *F*.

$$\left(\frac{\partial F}{\partial \alpha^{\dagger}} - \tanh(r) b^{\dagger} F\right) = 0 \tag{7}$$

And the solution is given by

$$F = e^{\tanh(r) \alpha^{\dagger} b^{\dagger}} \tag{8}$$

By substituting (8) into (6) and by properly normalizing the state vector, we get

$$\left| web\, 2.0 \right\rangle_{in \otimes overload} = e^{\tanh(r) \alpha^{\dagger} b^{\dagger}} \left| 0 \right\rangle = \frac{1}{\cosh\ r} \sum_m \tanh^m r \left| m \right\rangle_{in} \otimes \left| m \right\rangle_{overload} \tag{9}$$

Where $\left| m \right\rangle_{in}$ *and* $\left| m \right\rangle_{overload}$ are orthonormal bases (normal mode solutions) for H_{in} and $H_{overload}$ respectively. Now we intend to determine $\tanh(r)$ by calculating the probability for transcribing information into overload of web 2.0.We can calculate this probability as the following:

$$n_{in} = {}_{in \otimes overload} \left\langle web\, 2.0 \right| b^{\dagger} b \left| web\, 2.0 \right\rangle_{in \otimes overload} = \sinh^2(r) \tag{10}$$

Equation (10) shows that the internal stationary state of Web 2.0 can be represented by a maximally entangled two-mode squeezed state of inside and overload.

Entangled Two-Mode Squeezed States on Overload and Outside Hilbert Spaces of Web 2.0

Now, the second step is considered in extracting information from Web 2.0. For this purpose, we construct two Hilbert spaces with a set of operators of creation/annihilation that have the same commutation properties. The total Hilbert space of cell at this stage is the tensor product of the two spaces $H_{\text{web 2.0.}} = H_{overload} \otimes H_{outside}$, where in this case $H_{overload}$ and $H_{outside}$ denote the physical quantum states of overload and outside spaces, respectively.

The commutation relations satisfied by the various operators in these spaces are:

$$[d, d^{\dagger}] = 1 \qquad [d, d] = 0 \tag{11}$$

Where $d, d^{\dagger}$ are annihilation and creation operators that act on the outside space of Web2.0, respectively. The Bogoliubov transformation between these operators can be written as the following equation:

$$e = \cosh(r)\alpha + \sinh(r)d^{\dagger} \tag{12}$$

Where e is an annihilation operator that acts on the Hilbert space of Web 2.0. By using the Bogoliubov transformation, the condition

$$e\left|\text{web } 2.0\right\rangle_{out\otimes overload} = 0 \tag{13}$$

Gives rise to the so called thermal state conditions:

$$\cosh(r)\alpha + \sinh(r)d^{\dagger}\left|web2.0\right\rangle_{out\otimes overload} = 0 \tag{14}$$

Or equivalently

$$\alpha + \tanh(r)d^{\dagger}\left|web2.0\right\rangle_{out\otimes overload} = 0 \tag{15}$$

With similar calculations for the first stage, this study calculates the stationary state of Web2.0 at the second stage which is a maximally entangled two-mode state on the outside and overload Hilbert spaces as:

$$\left|web2.0\right\rangle_{out\otimes overload} = e^{\tanh(r)\alpha^{\dagger}d^{\dagger}}\left|0\right\rangle_{S} = \frac{1}{\cosh\ r}\sum_{m}\tanh^{m} r\left|m\right\rangle_{out}\otimes\left|m\right\rangle_{overload} \tag{16}$$

Where $\left|m\right\rangle_{out}$ *and* $\left|m\right\rangle_{overload}$ are orthonormal bases (normal mode solutions) for H_{out} and $H_{overload}$, respectively. This can obtain $\tanh r$ by calculating the probability for transcribing the information to the outside of Web 2.0. Now, this probability can be obtained as follows:

$$n_{out} = {}_{overload\otimes out}\left\langle web\,2.0\right|d^{\dagger}d\left|web\,2.0\right\rangle_{out\otimes overload} = \sinh^{2}(r) \tag{17}$$

Information Loss in Web 2.0

Now, the resulting information transformation from inside to outside can be calculated. Using Horowitz and Maldacena mechanism, this study describes the unknown effects of transcribing information of Web 2.0 by an additional unitary transformation S (Horowitz & Maldacena, 2004). Also, by using Gottesman and Preskill idea, the present research introduces a unitary transformation *U* to describe the interactions between the inside and overload information (Gottesman & Preskill, 2004).

$${}_{in\otimes overload}\left\langle web2.0\right| = {}_{in\otimes overload}\left\langle web2.0\right|(S\otimes I)U \tag{18}$$

By using Gottesman and Preskill method, the information transformation from inside to outside is calculated.

$$T_{web2.0} = {}_{in\otimes overload}\langle \; web2.0' \,|\, web2.0 \; \rangle_{overload\otimes out}$$

$$= \frac{1}{\cosh\ (r)\cosh\ (r')} \sum \tanh^{m}(r)\tanh^{m}(r')$$

$$\otimes in\langle m|_{overload}\langle m|S\otimes U|m\rangle_{overload}|m\rangle_{out} \qquad (19)$$

$$f = |T_{web2.0}|^2 = \frac{1}{\cosh^2(r)\cosh^2(r')} \sum \tanh^{m+m'}(r)\tanh^{m+m'}(r') \qquad (20)$$

$$\otimes {}_{in}\langle m'|_{overload}\langle m'|_{overload}\langle m|_{out}\langle m|SS^{\dagger}\otimes UU^{\dagger}|m\rangle_{in}|m\rangle_{overload}|m'\rangle_{overload}|m'\rangle_{out}$$

$$= \frac{1}{\cosh^2(r)\cosh^2(r')} \sum \tanh^{m+m'}(r)\tanh^{m+m'}(r')$$

$$\otimes {}_{in}\langle m'|m\rangle_{in}\ {}_{overload}\langle m'|m\rangle_{overload}\ {}_{overload}\langle m|m'\rangle_{overload}\ {}_{out}\langle m|m'\rangle_{ou}$$

$$= \frac{1}{\cosh^2(r')\cosh^2(r)} \sum \tanh^{2m}(r)\tanh^{2m}(r')$$

$$= \frac{1}{\cosh^2(r')\cosh^2(r)} \otimes \frac{1}{1-\tanh^2(r')} \frac{1}{1-\tanh^2(r)}$$

$$= \frac{\cosh^2(r)\cosh^2(r')}{\cosh^2(r')\cosh^2(r)} = 1$$

If the information transformation from the inside to the state of outgoing should be complete, the value of *f* should be one. Evidently, the value of *f* is unity, so that the information isn't lost in Web 2.0.

Conclusion

This investigation extends Gottesman and Preskil method to calculate information loss in Web 2.0. This study calculates the amount of information transformation from inside to outside in Web 2.0. To this end, it introduces three Hilbert spaces that belong to the degrees of freedom of inside, outside, and overload. At the first stage, it is shown that the internal stationary state of Web 2.0 can be represented by a maximally entangled two-mode squeezed state of the inside and overload. At the second stage, the state of Web 2.0 can be described by a maximally entangled two-mode squeezed state of the overload and outside. The amount of information transformation can be obtained by projecting the state at the first stage on the state at the second one. It is observed that the information is not lost in Web 2.0. Different spaces existing in web, specifically web 2.0 which are made up of new web-based services of interactions between people and increased sharing and free and voluntary information transfer leads to entanglement, hide or loss of information and complicated the survey of real and unreal information. Moreover, Internet naming plans, URL, protocols and signing language has increased which made restoring information in search engines more difficult. But lack of complete restoring of information does not mean the lack of understanding and surveying of real and unreal information, therefore, based on the results of this study, information are not lost in Web 2.0, but technology advancement makes possible restoring of all information in web and we should attempt to find ways for availability and restoration of these information.

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