Social Radar Brain－Evaluation and Control of Circulation Societies－

Hiroshi Kawamura

Kobe University (Emeritus Professor), Kobe, Japan

corresponding author: hirokawa@hcn.zaq.ne.jp

(Received 30 November 2009; accepted 7 December 2009)

The purpose of this paper is to propose a 'social radar brain' model which enables us to evaluate circulation societies judging from fair and objective points of view. Recurrence, fairness, symbiosis and safety are employed as quantitative evaluation indices which compose E-phase plane. Figures illustrated in such an E-phase plane show the healthiness of circulation societies. The bigger and nearer circles become such figures, the more healthy and sustainable become such societies. Furthermore, the following applicabilities are shown: human and social thoughts, quantification of indices, inverse Lissajous analysis and fuzzification of E-phase plane.

Key words: Social radar brain, Circulation society, Evaluation and control, Quantification of indices, Lissajous curve, Fuzziness

1. INTRODUCTION

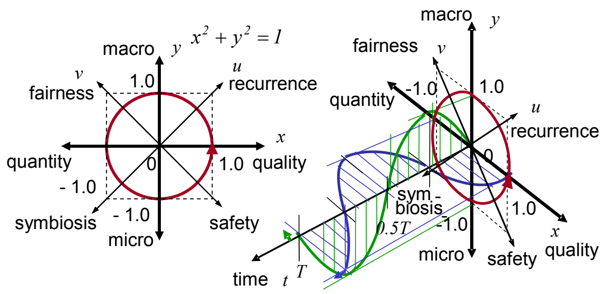
Our modern society has been established in control of combined political and economic powers. Generally speaking, it is very difficult for them to take account of people's opinions and interests, because in such a society fair and objective health monitoring systems do not always work effectively.

The purpose of this paper is to propose a 'social radar brain' model by which societies can be evaluated judging from fair and objective points of view [1]. In this paper, a resource circulation society is employed for such evaluation, because circulation systems can make societies sustainable and can be dealt with by quantitative methods.

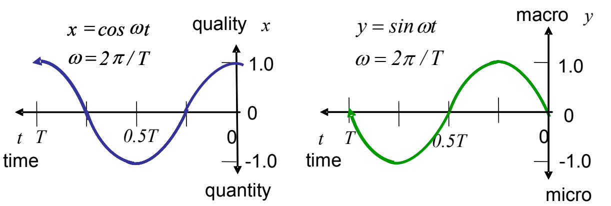
From old times, ethics have been argued regarding virtues and/or thoughts of persons [2]. However, in this paper, they belong to societies. Usually, the word of social brain means social functions of human brains [3]. However, in this paper, it means literally the very brain that societies should possess.

2. MECHANISM OF SOCIAL RADAR BRAIN

The proposed model of social radar brain consists of two rectangular metaphysical axes; quantity ⇔ quality and macro ⇔ micro, and two rectangular physical axes; recurrence ⇔ symbiosis and fairness ⇔ safety. The former two correspond to social points of view, the latter two to social phenomena which can be observed quantitatively. These axes compose *E*-phase plane as shown in Fig.1(a) where the former are the principal axes, *x* and *y*, and the latter the diagonal axes, *u* and *v*. *E* means "evaluation." The circle in Fig.1(a) is given in a balanced case



(a) E-phase plane (b) Composition of Lissajous curve



(c) *Cos* and *sin* curves of the principal co-ordinates, *x* and *y*

Fig.1. Mechanism of social radar brain (in balanced case)

and transformed into various shapes according to unhealthiness behaviors of real societies.

A balanced circle is illustrated as a Lissajous curve where the principal co-ordinates *x* and y draw *cos* and *sin* curves with the same amplitude and phase difference $\pi/2$ as shown in Fig.1(b) and (c). Such a circular rotation is similar to the behavior of radar systems, and active places on the E-phase plane are analogous to front, left, rear and right parts in human brains. Furthermore, functions in evaluation and control of societies are the very ones of social brains.

Wilber has proposed four quadrants of the cosmos [4] which are described with principal axes; interior ⇔ exterior and individual ⇔ collective, and diagonal axes; cultural ⇔ behavioral and intentional ⇔ social. On the diagonal axes everything in the world and cosmos can be located as a static point statically. However, evaluations of a society can be illustrated dynamically as figures on the E-phase plane of the proposed social radar brain.

3. APPLICABILITIES

3.1 Thoughts, Ideologies, etc.

On the analogy of human brains usual and representative thoughts and ideologies may be described with the ellipses in the *E*-phase plane as shown in Fig.2.

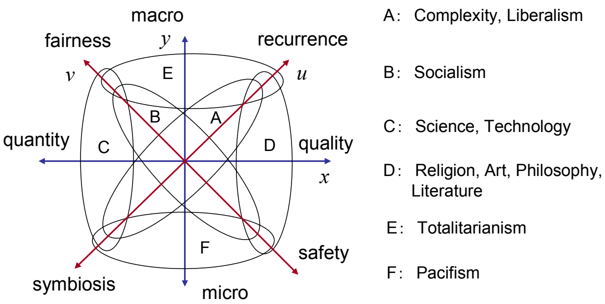


Fig.2. Thoughts, ideologies, etc. in *E*-phase plane

Fig.2 shows that almost thoughts and ideologies are expressed as ellipses and that they exist only at partial parts of the *E*-phase plane of the social radar brain. Each thought should have logical consistency, so its activity is restricted to limited parts of human brains.

3.2 Quantification of physical axis evaluation

When a three-node network is employed as the simplest resource circulation society as shown in Fig.3, its simultaneous differential equations are shown by Eq. (1). *x, y* and *z* can be considered as producer's, consumer's and nature's resources, respectively. When the total resources are assumed to be

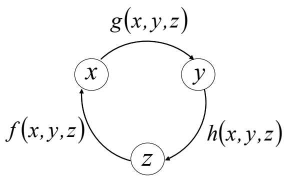


Fig.3. Resource circulation society

$$\left.\begin{aligned}\dot{x} &= f(x,y,z) - g(x,y,z)\\ \dot{y} &= g(x,y,z) - h(x,y,z)\\ \dot{z} &= h(x,y,z) - f(x,y,z)\end{aligned}\right\} \quad (1)$$

$$\left.\begin{aligned}\dot{x} + \dot{y} + \dot{z} &= 0\\ x + y + z &= K_0\end{aligned}\right\} \quad (2)$$

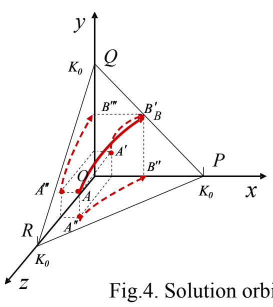


Fig.4. Solution orbits

constant K_0, *x* and *y* are considered to be independent variables as shown by Eq.(2) and in Fig.4 which shows that every solution orbit AB exists on △PQR.

Based on Eqs.1,2 and Figs.3,4, the indices, recurrence *R*, fairness *F*, symbiosis S_m and safety S_f of the physical axes, *u* and *v*, are given quantitatively as foll0ws:

Recurrence *R*:

Recurrence index of *x*, R_x, can be evaluated as a function of $\dot{x}$ shown in Fig.5. Solution orbits can be illustrated in the *x-y* R-phase plane shown in Fig.6 where R means "resources," so that three kinds of isoclines are given according to $\dot{x} = \dot{x}_L, 0, \dot{x}_U$ in the same plane.

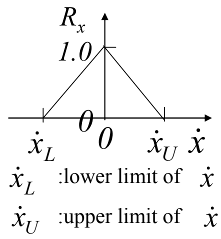


Fig.5. Recurrence index R_x

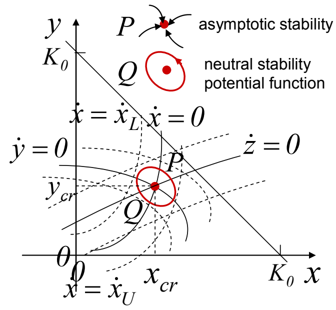


Fig.6. *x-y* R-phase plane for recurrence index *R*

The rest recurrence indices, R_y and R_z, can be calculated by the same method as shown in Fig.5, and the isoclines for them are illustrated in Fig.6 where point P is a critical one with co-ordinates x_{cr} and y_{cr}. The total recurrence index *R* is

$$R = \sum_{i=x,y,z} w_i R_i, \qquad \sum_{i=x,y,z} w_i = 1 \qquad (3)$$

R=1 when the critical point P in Fig.6 is asymptotic stability, and $1 \geq R \geq 0$ when the potential function Q around the neutral stability P is inside the broken isoclines.

Fairness *F*:

Fairness index of *x*, F_x, can be evaluated as a function of x_{cr} shown in Fig.7 where k_x is lower limit ratio of x_0, and x_0 is assumed resource of *x*'s node proportional to its population ratio of *x*'s node population to the total one. Regarding $x = k_x x_0$, a broken line is given in the *x-y* R-phase plane shown in Fig.8.

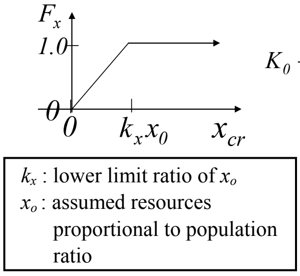


Fig.7. Fairness index F_x

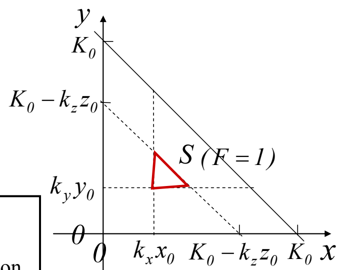


Fig.8. *x-y* R-phase plane for fairness index *F*

The rest fairness indices, F_y and F_z, can be calculated by the same method as shown in Fig.7, and the critical lines for them are illustrated as the broken ones in Fig.8. R in Eq.(3) is replaced by F. Consequently, $F = 1$ when P or Q is inside the triangle S in Fig.8, and $1 \geq F \geq 0$ when outside it.

Symbiosis S_m:

Symbiosis index S_m can be also evaluated by the same method as fairness F mentioned above as shown in Figs.9,10.

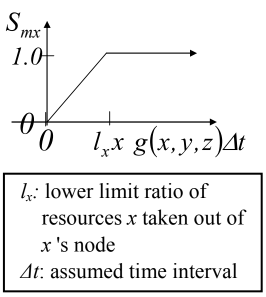


Fig.9. Symbiosis index $S_{m\,x}$

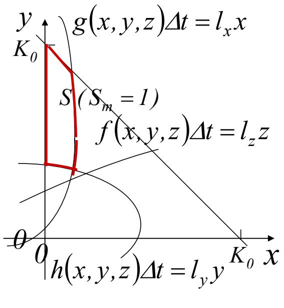


Fig.10. x-y R-phase plane for symbiosis index S_m

However, there are two points different from F as follows: Firstly, S_m is given by a function of resources taken out of corresponding node as shown in Fig.9. Secondly, the critical lines are given by three curves as shown in Fig.10. R in Eq.(3) is replaced by S_m. Consequently, $S_m = 1$ when P or Q is inside the region S in Fig.10 , and $1 \geq S_m \geq 0$ when outside it.

Safety S_f:

As for safety S_f, its evaluation is performed by almost the same way as fairness F as shown in Figs.11,12.

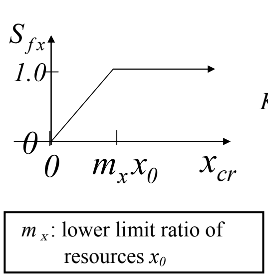


Fig.11. Safety index S_{fx}

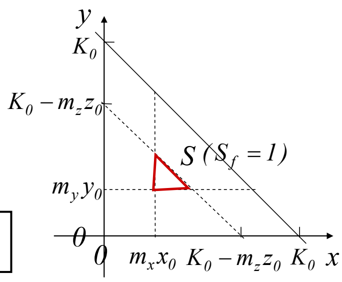


Fig.12. x-y R-phase plane for safety index S_f

R in Eq.(3) is replaced by S_f. Consequently, $S_f = 1$ when P or Q is inside the triangle S in Fig.12, and $1 \geq S_f \geq 0$ when outside it.

3.3 Inverse Lissajous Analysis

Using the observed values of the diagonal and physical axes, u and v, mentioned above, we can draw an assumed ellipse in the E-phase plane which shows a healthiness grade regarding a resource circulation society as shown in Fig.13.

Points A, B, C, D are given by the observed values through which a diagonal rectangular PQRS is determined as shown in Fig.13. Here a regulated ellipse inscribed in such a

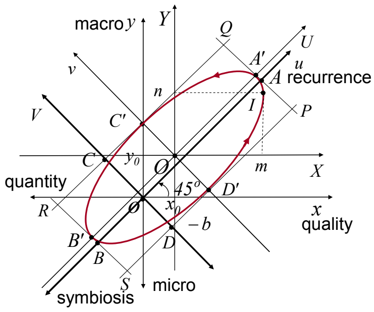


Fig.13. Assumed ellipse in x-y E-phase plane

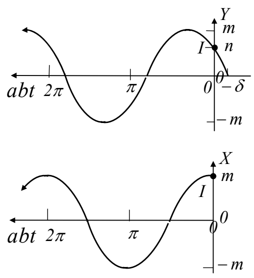


Fig.14. *Sin* and *cos* curves of co-ordinates X and Y

rectangular at points A', B', C', D' is assumed, and new co-ordinate systems, X-O-Y and U-O-V parallel to the original ones, x-o-y and u-o-v. A,B,C,D,A',B',C' and D' are given by

$$\left.\begin{array}{l} oA = R,\ oB = S_m,\ oC = F,\ oD = S_f \\ OA' = a,\ OB' = -a,\ OC' = b,\ OD' = -b \end{array}\right\} \quad (4)$$

By applying inverse Lissajous analysis called by the author to such an ellipse, we can get sin and cos curves regarding the principal co-ordinates X and Y as shown in Fig.14 and by Eq.5 which show hidden and fundamental waves and rhythms of the proposed social radar brain.

$$X = \sqrt{\frac{a^2+b^2}{2}}\cos abt, \quad Y = \sqrt{\frac{a^2+b^2}{2}}\sin(abt+\delta) \quad (5)$$

$$\tan\delta = \frac{a^2-b^2}{2ab}$$, where δ is quasi-phase difference.

In Figs.13,14 the point I means an initial one. The new origin O has the co-ordinates (x_0, y_0), so by using $x = X + x_0$ and $y = Y + y_0$, these curves can be translated into ones described with the original co-ordinates, x and y.

3.4 Fuzzification of E-Phase Plane Figures

The eight factors in resource circulation societies have fuzziness inevitably as follows: subjectivity, insufficient information, errors, and so on. Such a fuzziness can be easily illustrated and estimated by means of α-level sets [5,6] on the E-phase plane of the model of social radar brain.

α-level set A_α is determined as a region as shown in Fig.15 and by Eq.(6) where $\mu_A(x,y)$ is membership function of fuzzy set A. For simplicity, a balanced circle shown in Fig.16 is employed instead of Fig.13 as a figure in E-phase plane.

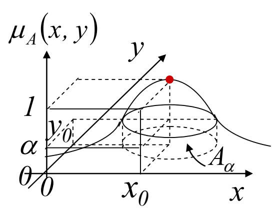


Fig.15. α - level set A_α

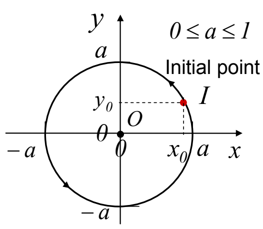


Fig.16. Balanced circle in E-phase plane

$$A_\alpha = \{(x,y)/\mu_A(x,y) \geq \alpha\}, \quad \alpha \in [0,\ 1] \quad (6)$$

The effects of fuzzification on the initial point I and coefficient a are visualized as shown in Figs.17 and 18 where α-level sets A_α are given by circular belts.

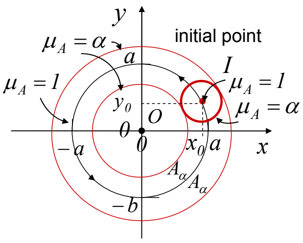


Fig.17. α -level sets by initial point

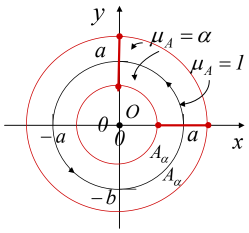


Fig.18. α -level sets by coefficient a

Even regarding *cos* and *sin* waves of the principal co-ordinate x and y, α-level sets A_α are shown in Figs.19,20 and 21 due to vertical shifts, quasi-time differences and periods, respectively. Quasi-time and period differences t_δ, T are given by

$$t_\delta = \delta / a^2 , \quad T = 2\pi / a^2 \tag{7}$$

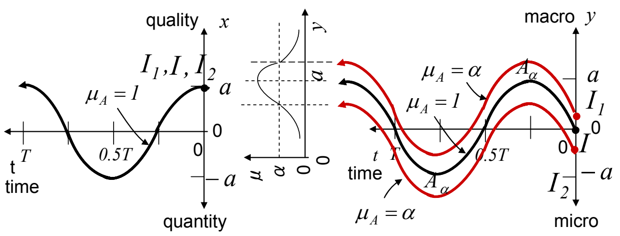
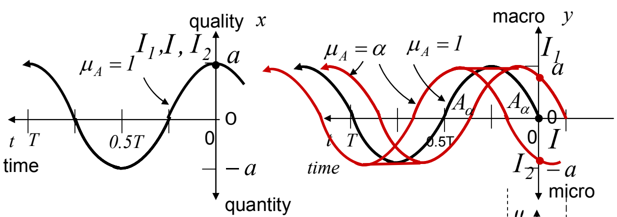


Fig.19. α-level sets in *cos* and *sin* waves of principal co-ordinates x and y by vertical shifts



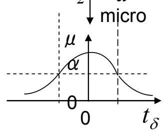


Fig.20. α-level sets in *cos* and *sin* waves of principal co-ordinates x and y by quasi-time differences

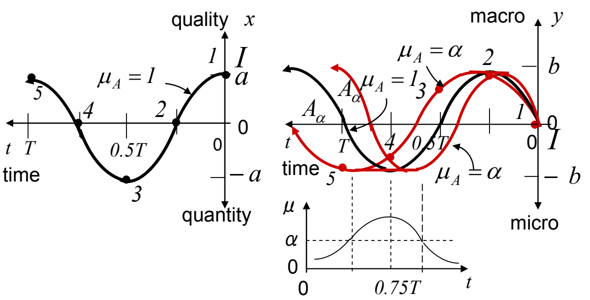


Fig.21. α-level sets in *cos* and *sin* waves of principal co-ordinates x and y by period differences

By drawing Lissajous curves of the *cos* and *sin* waves in Figs.19, 20 and 21, their α-level sets A_α in the E-phase plane are illustrated as shown in Figs.22, 23 and 24, respectively.

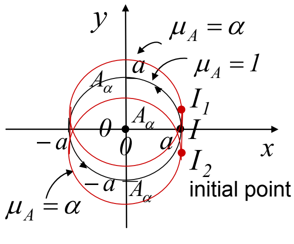


Fig.22. α-level sets of circle in E-phase plane by vertical shifts

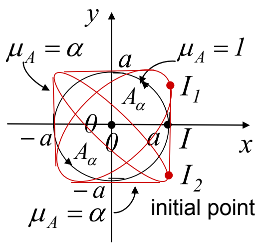
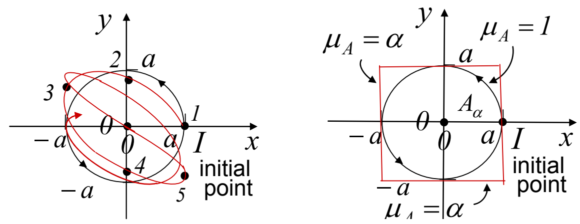


Fig.23. α-level sets of circle in E-phase plane by quasi-time differences



(a) A part (b) Outer limit

Fig.24. α-level sets of circle in E-phase plane by period differences

I, I_1, and I_2 are assumed initial points, and the numbers 1, ~ ,5 in Fig.24(a) correspond to the ones in Fig.21. The Lissajous curve in Fig.24(a) is so complicated that its outer limit, that is, α-level set A_α is considered to be given as a square in Fig.24(b).

4. CONCLUSIONS

In this paper the author proposed a model of social radar brain as a method for evaluation and control of resource circulation societies. An ellipse drawn in the E-phase plane shows a healthiness grade of such societies.

Applying inverse Lissajous analysis to such ellipses, the hidden tendencies of fundamental view points of societies can be made clear. By means of α-level sets, the fuzzification of these figures can be visualized.

REFERENCES

[1]Kawamura,H.(2006). Evaluation and Design of Social Systems by Recurrent Model: Proc. of the 50th Annual Conference of the Institute of Systems, Control and Information Engineers, Kyoto, May 2006, 109-110. (in Japanese).

[2]Blackburn,S.(2001):Ethics, a very Short Introduction: Oxford University Press.

[3]Gazzaniga,S.M.(1985). The Social Brain, Discovering the Networks of the Mind: Basic Books,inc., Publishers.

[4]Wilber,K.(1996). History of Everything: Shambhala.

[5]Zadeh,L.A.(1965). Fuzzy Sets: Information and Control. Vol.8, 383-353.

[6] Zadeh,L.A.(1971). Similarity Relations and Fuzzy Orderings: Information Sciences. 3, 177-200.