# About Oval （Doval）

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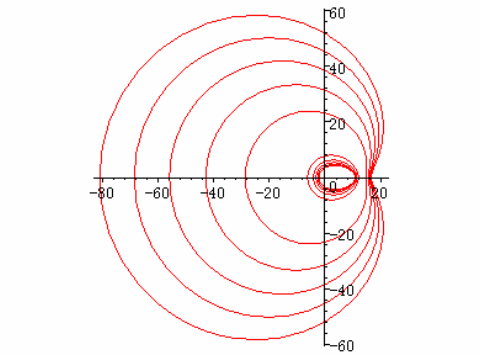
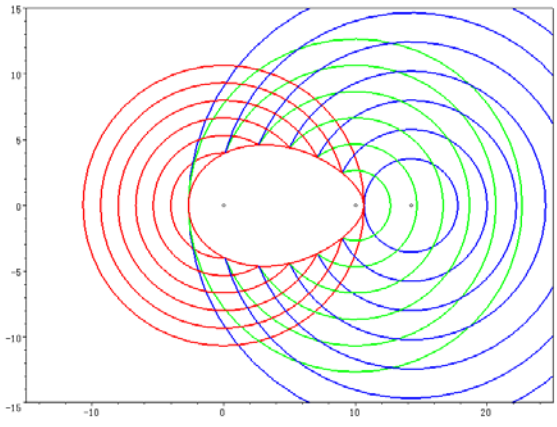
IWAKUNI near HIROSHIMA




Confocal Doval

共焦点 Doval




Three　focus　points

Trade Mark　($E_R$=0.9,$E_L$=0.6)

# 1. Introduction

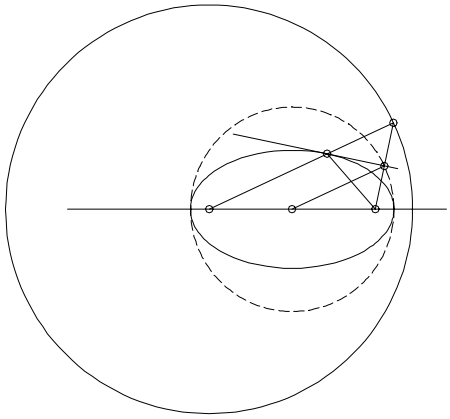


Fig.1. Composition of Tangent on Ellipse

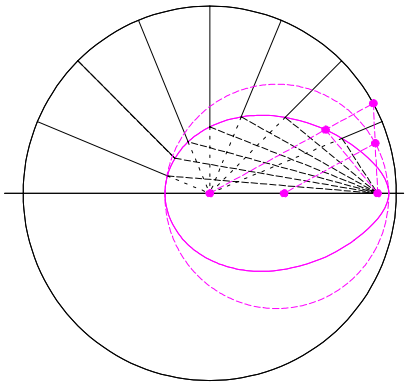


Fig.2. Oval extended from Ellipse

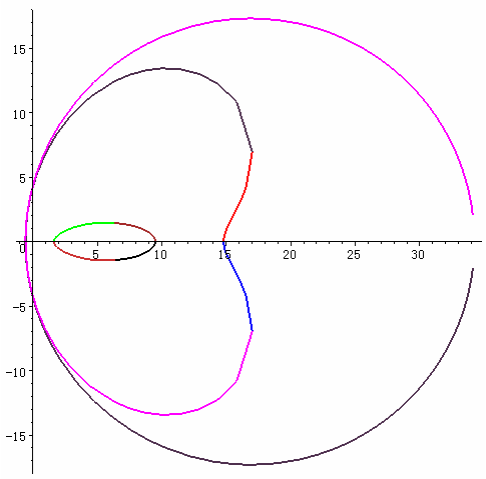



Fig.3.Chocoid extended from Doval

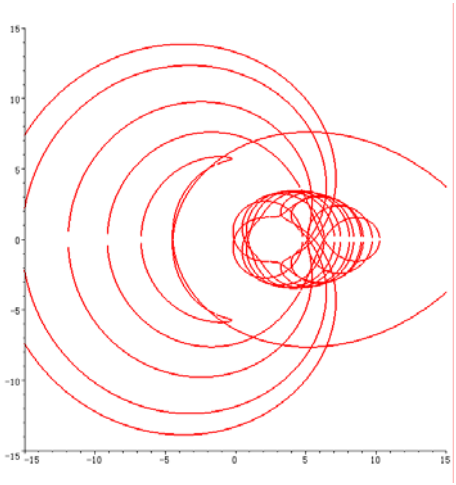



Fig.4. Tajicoid extended from the Oval

Tangent line is a perpendicular bisector in Fig.1

We extend bisector(1:1) to (n:m), then Oval is obtained.

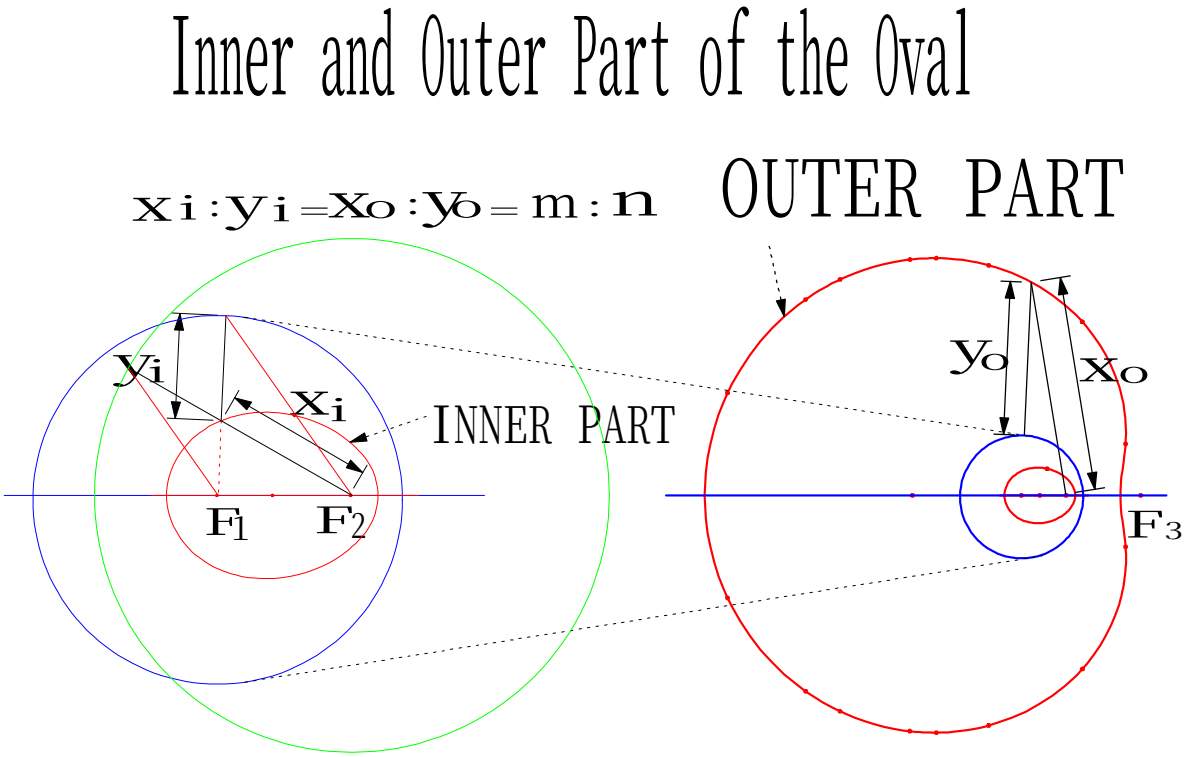
When ratio is (n:m), then DOVAL(theOval) is also defined by $mR1 \pm nR2 = kc$。

But Chocoid and Tajicoid have not yet a simple equation. It can be only defined by Maple Program which is made by Definition-Composition of Chocoid and Tajicoid respectively.

by H.E

## 2. Definition of Doval

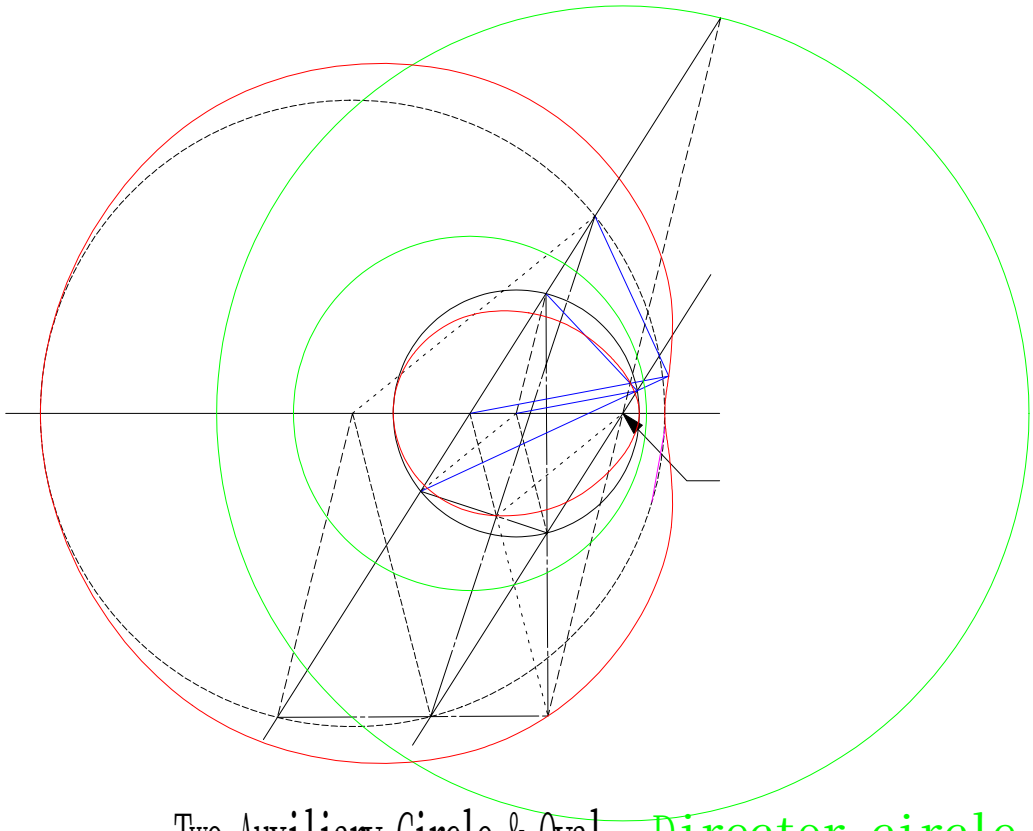
We call inner and outer part of Oval as DOVAL




$$m r_1 \pm n r_2 = k c$$

Radius of Director circle = kc/m, kc/n

## 2’ Definition of Doval



Two Auxiliary Circle & Oval  Director circle

Radius of Auxiliary Circle =kc/(m+n), kc/(m-n)

## 3. Distance between Main Points of Doval

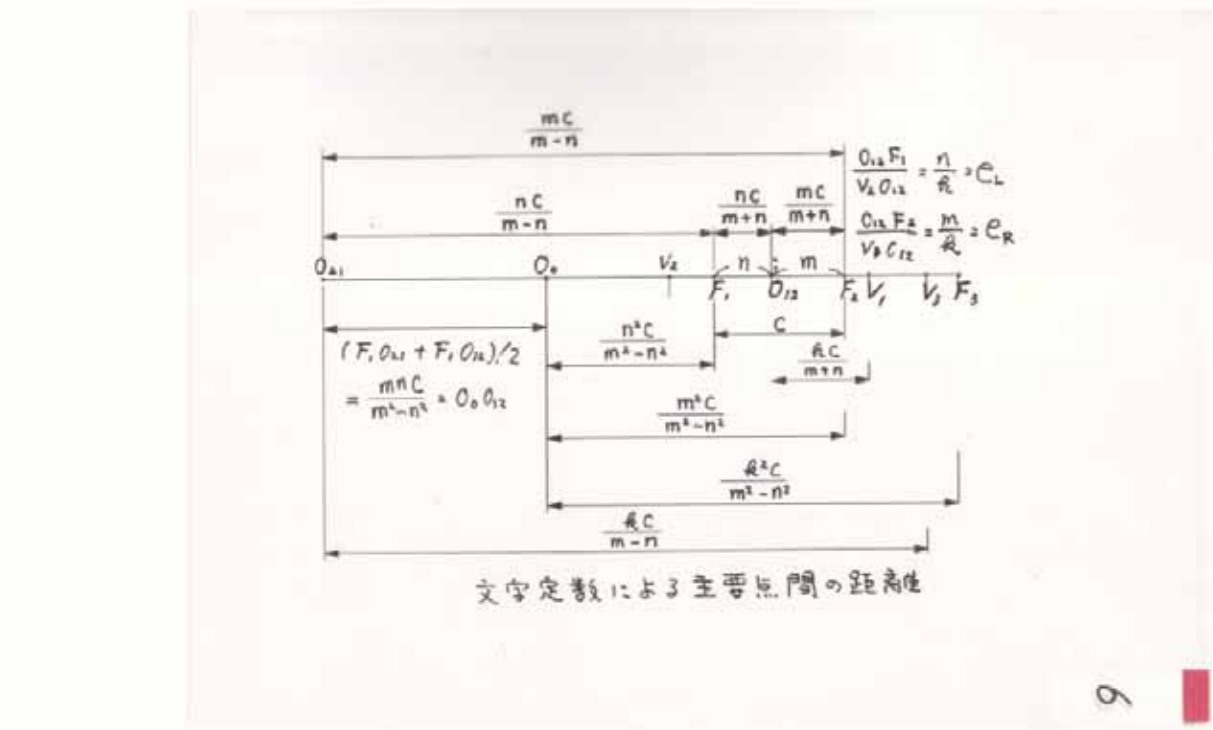



Table 1

*We ashume Doval is defined by $mr_1 \pm nr_2 = kc$

*$O_{21}, F_1, O_{12}, F_2$ : harmonic range of Points

*$O_0$ : Middle Point between two CENTERS OF auxiliary Circles（or named Center of equivalent Circles）

*Pairs of these four $O_0, F_1, F_2, F_3$ on a line define Doval.

Main result of this figure is $O_0F_1 = n^2/(m^2-n^2)$

$O_0F_2 = m^2/(m^2-n^2)$

$O_0F_3 = k^2/(m^2-n^2)$

Raius of three equivalent Circle

E1=mn/(m^2−n^2), E2=kn/(m^2-n^2), E3=km/(m^2-n^2) BY H.E

## 4. PROPOSITION

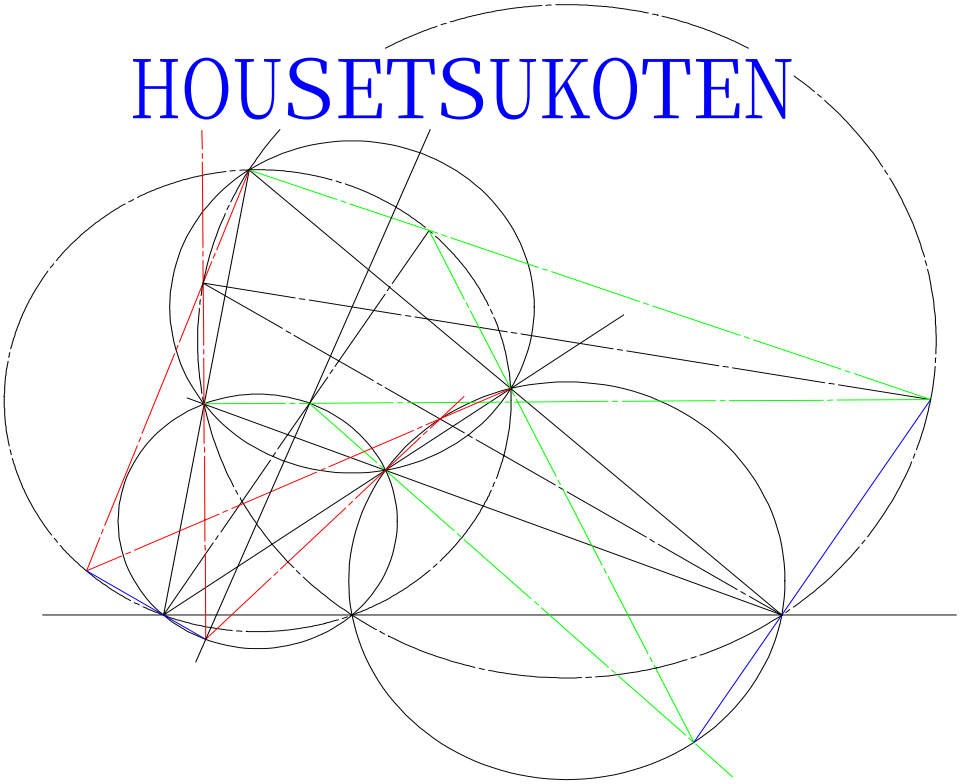



Fig.8. Green lines are tangent of Doval.

Red lines are normal lines of Doval

----STANDARD FORM OF Doval Equation--

$mr_1 \pm nr_2 = kc$ is transformed to followings

$$(m^2-n^2)^2\{y^2+X^2-(\frac{k^2m^2+k^2n^2+m^2n^2}{(m^2-n^2)^2})c^2\}^2$$

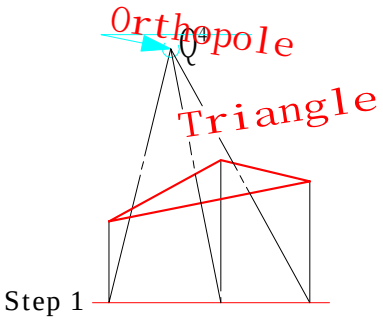
$$=-\frac{8k^2m^2n^2c^3}{m^2-n^2}X+\frac{4k^2m^2n^2(k^2+m^2+n^2)c^4}{(m^2-n^2)^2}$$

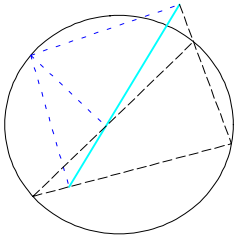
$$X=x+\frac{n^2c}{m^2-n^2}$$

by H.E

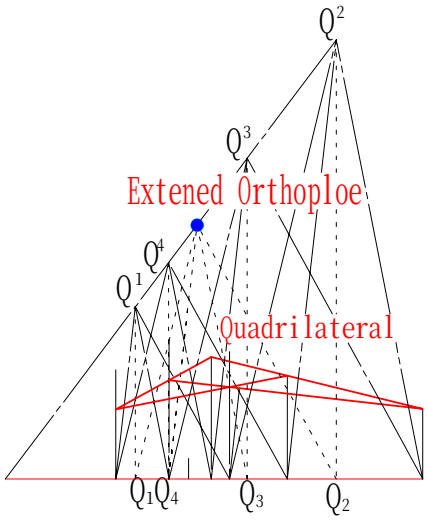
# 5． Infinity Chain Theorem

We use following theorem in order to define Chocoid and Tajicoid.

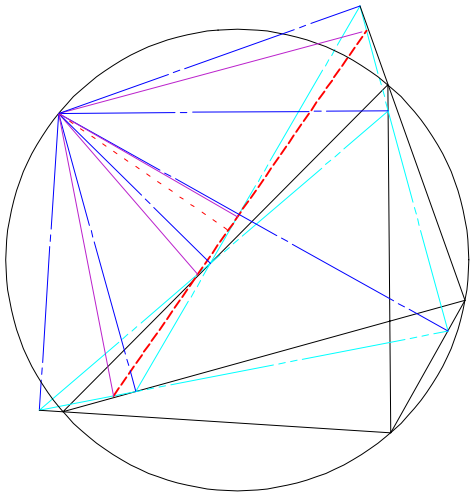


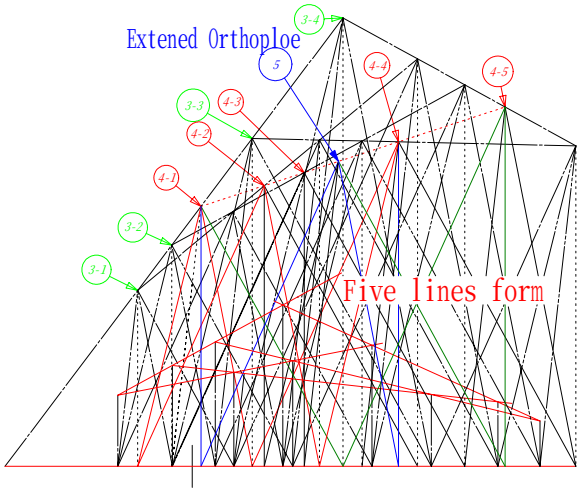
Simson Theorem (Step1(Chain3))




Step 2 (Chain 4)

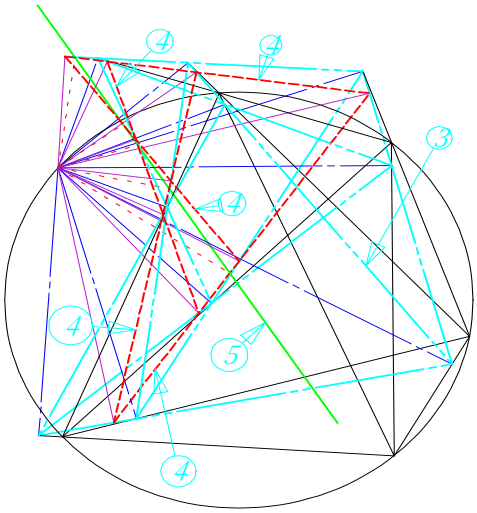


Step 2(Chain 4)




Step 3 (Chain 5)

Fig.9. Orthopole Chain



Step 3 (chain 5)

Fig.10. Simson Chain by H.E

# 6． Relation of Extended Curves Chocoid and Tajicoid

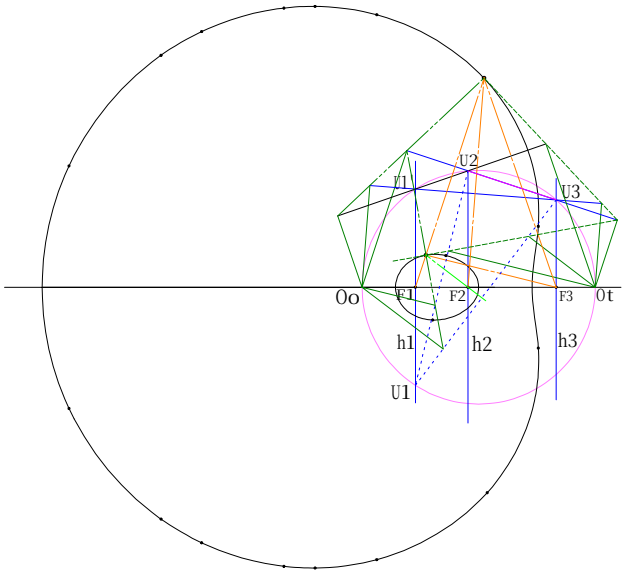



Fig.11.

In this fugure. Orthopole and Simson cross-point are on same position.

(1) Extension of Doval using extended Simson theorem-Composition。

Tajicoid is defined using This figures.
Program is in the proceeding.

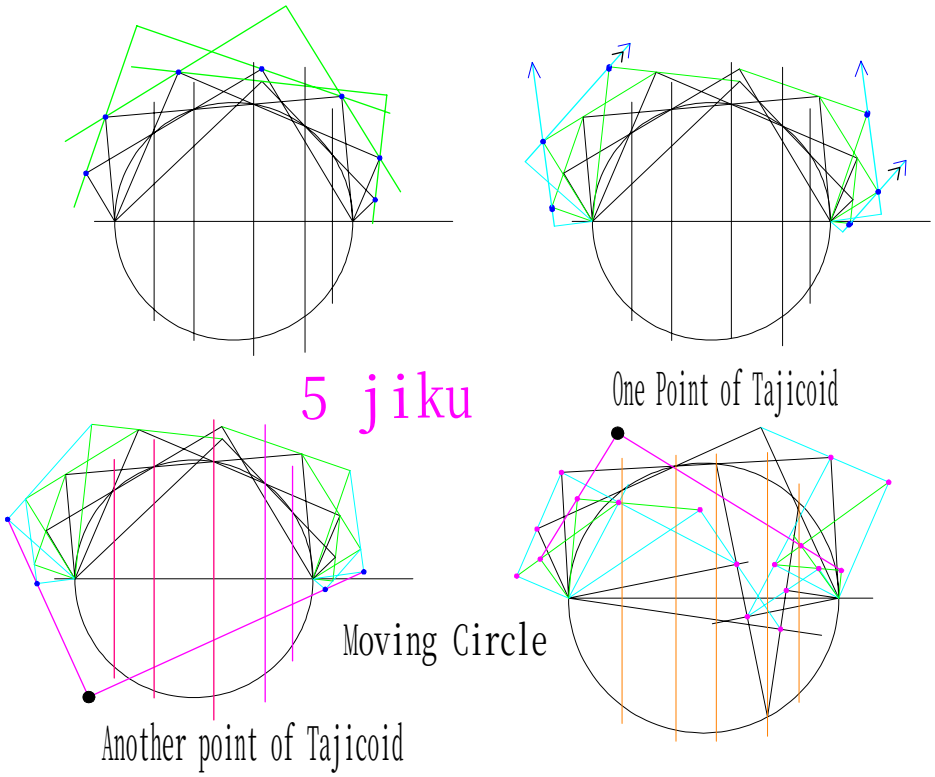



Fig.12. Def. Figure of Tajicoid by H.E

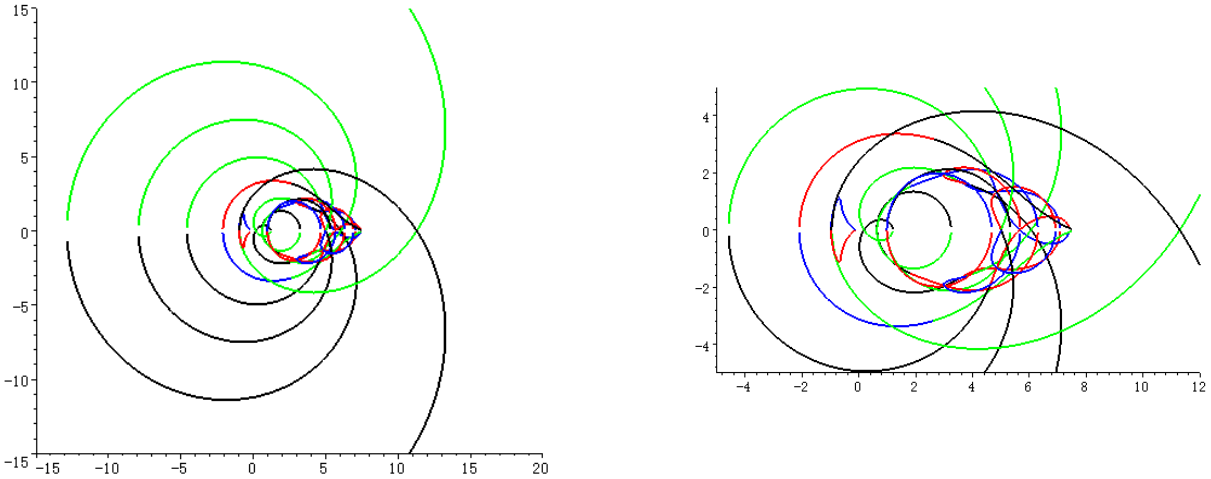


FIG.13.　Tajicoid パラメーター1，2，3，4，5

(2) Extension of Doval using extended Orthopole theorem-Composition。

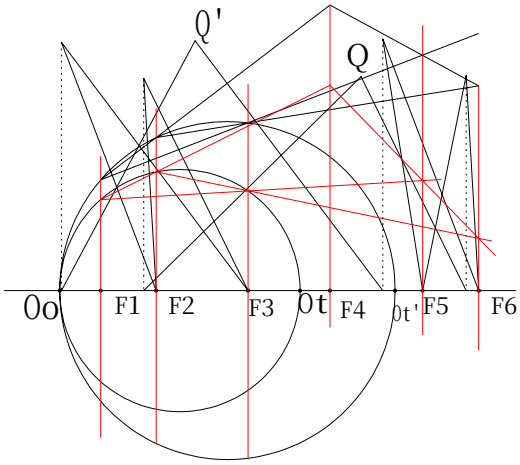
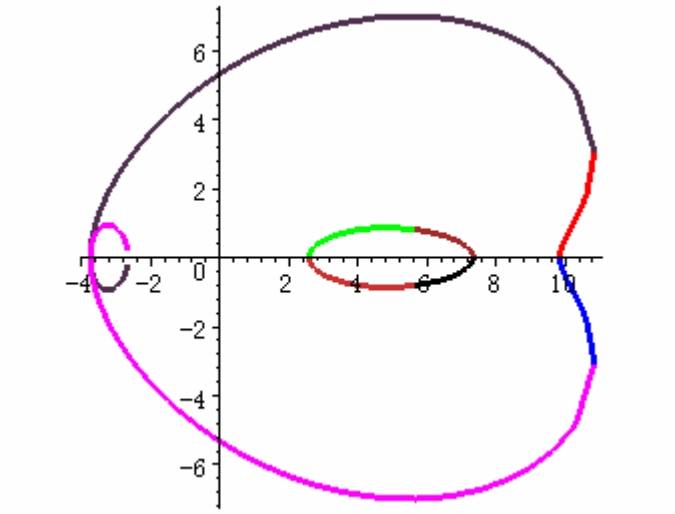


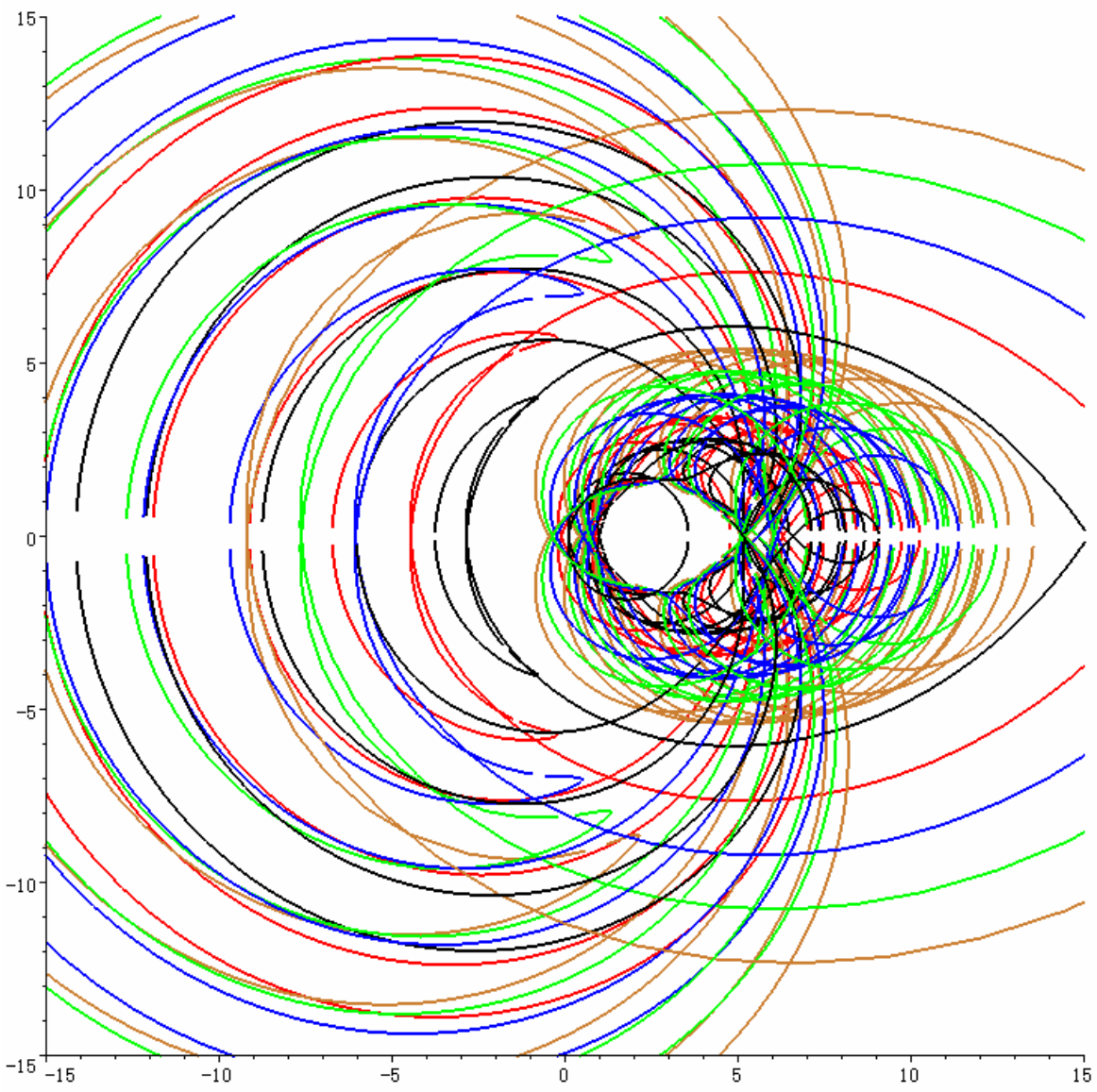

FIG.14.　DEF Figure Of Chocoid



Parameter x1 = 1, x2 = 2, x3 = 3, x4 = 5, x5 = 150/23, x6 = 165/19

Fig.15.　Chocoid with 6foci　　by　H.E

# 7． Confocal Tajicoid




Parameter　$O_0$=－1、－2、－3、－4、－5,

F1～F5= 1．5, 2, 3, 4, 5

We can draw confocal Tajicoid

because Tajocoid have 5 foci.

Fig.16.　Confocal Tajicoid

By　H.E

# 8. Conclusion

Today I mainly speak about the Extended Curves.

For extension of Doval, We use Extended Orthopole-Treorem

And Extended Simson lines.

Doval has Many properties as writing in proceeding.

But, It is not easy for short time to explain their proof.

So, Today, I intended to show raff sketch how to extend Doval to Extended Curves Tajicoid and Chocoid.

Many Doval propositions exist. And we can feel very fun to find new theorem of Doval.

In the future, we want to find out some applications of Doval.

It might be an application in Mathematics or physics.

Here is Unsolved Probrem of Doval

(1) To find extended conjugate diameter of ellipse.

(2) To find Eccentric angle of Doval like Eliipse

(3) To solve the motion of Oval (Doval) or Ovaloid.

(4) To extend Tajicoid and Chocoid to get Infinity chain of Curves

Anyway, at least, we believe that our research contribute to Curve theorem and to Geometry and CG.

Thanks a lot for your attentions. By H.E