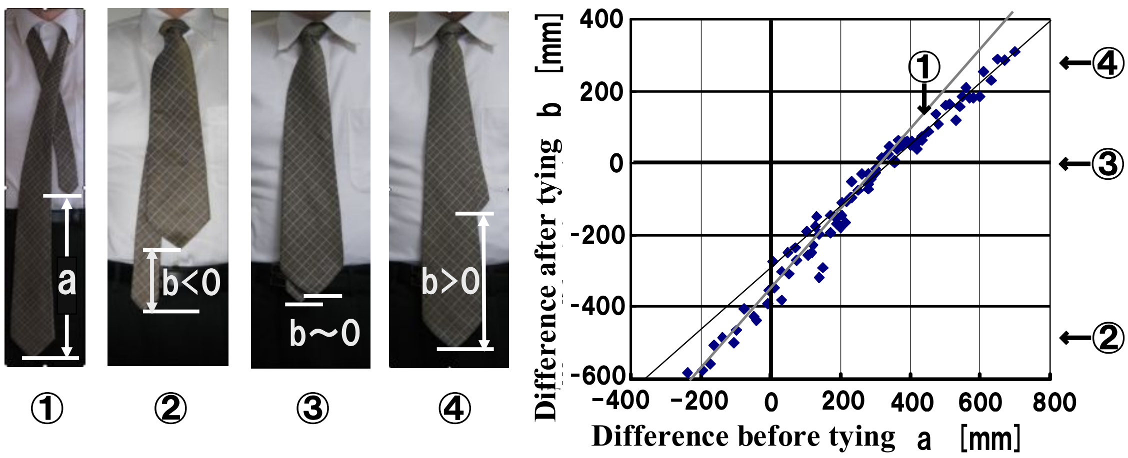

Fig. 1. Measured differences in length of two tails after the tying against those before the tying.

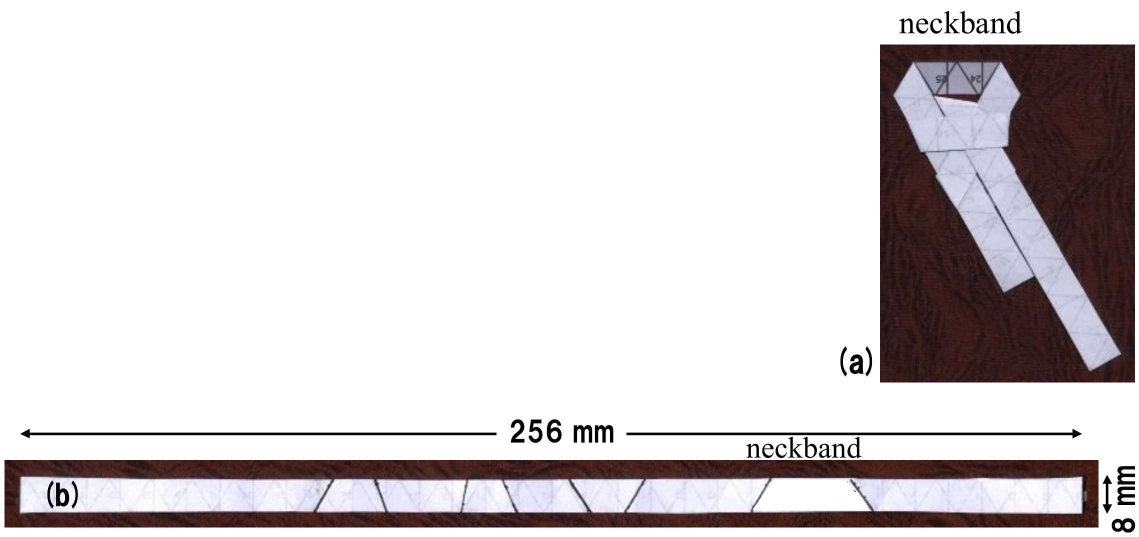

Fig. 2. (a) A paper model of Semi-Windsor Knot and (b) its development elevation. The eight inclined solid lines are lines for mountain fold.

n. This remind us of the Malthus equation representing the growth of population N with time t;

$$dN/dt = \alpha N. \tag{4}$$

Equation (4) obeys under the additivity rule and tells the population grows exponentially with the time.

In Eq. (4), the constant α is called as Malthus coefficient. The simplest modification of the exponential growth of population is done by substituting α with

$$\alpha = \alpha_0 - \alpha_1 N. \tag{5}$$

Then Eq. (4) is transformed as follows;

$$dN/dt = \alpha_0 N - \alpha_1 N^2. \tag{6}$$

This is well-known "logistic equation" giving typically an S-shaped curve as a solution with the saturated value

$$N = \alpha_0/\alpha_1. \tag{7}$$

Obviously, the logistic Eq. (6) does not obey additivity rule and the system is essentially nonlinear.

Following an analogious procedure with Eqs. (4)–(6), we can substitute Eqs. (1)–(3) with

$$a = a_0 + a_1 x \tag{8}$$

which makes the linear Eq. (3) into a nonlinear one.

In this case, the equation representing upper edge and the lower edge corresponding to Eqs. (1) and (2) is expressed as

$$y = a_1 x^2 + a_0 x + b \tag{9}$$
$$y = -a_1 x^2 - a_0 x - b. \tag{10}$$

Figure 7 typically gives a example of this stripes.

Figure 7 can be considered as a simplified model of Fig. 3(a).

5. Conclusion

If we consider the fact that the measured curves in Figs. 1 and 3(b) can be approximated by two straight lines, the necktie is a combined linear system of Fig. 6 with different two value of a, resulting in approaching a nonlinear system