



PCA-based Bend Feature Selection Applied in Detection of Ice Cream Stick

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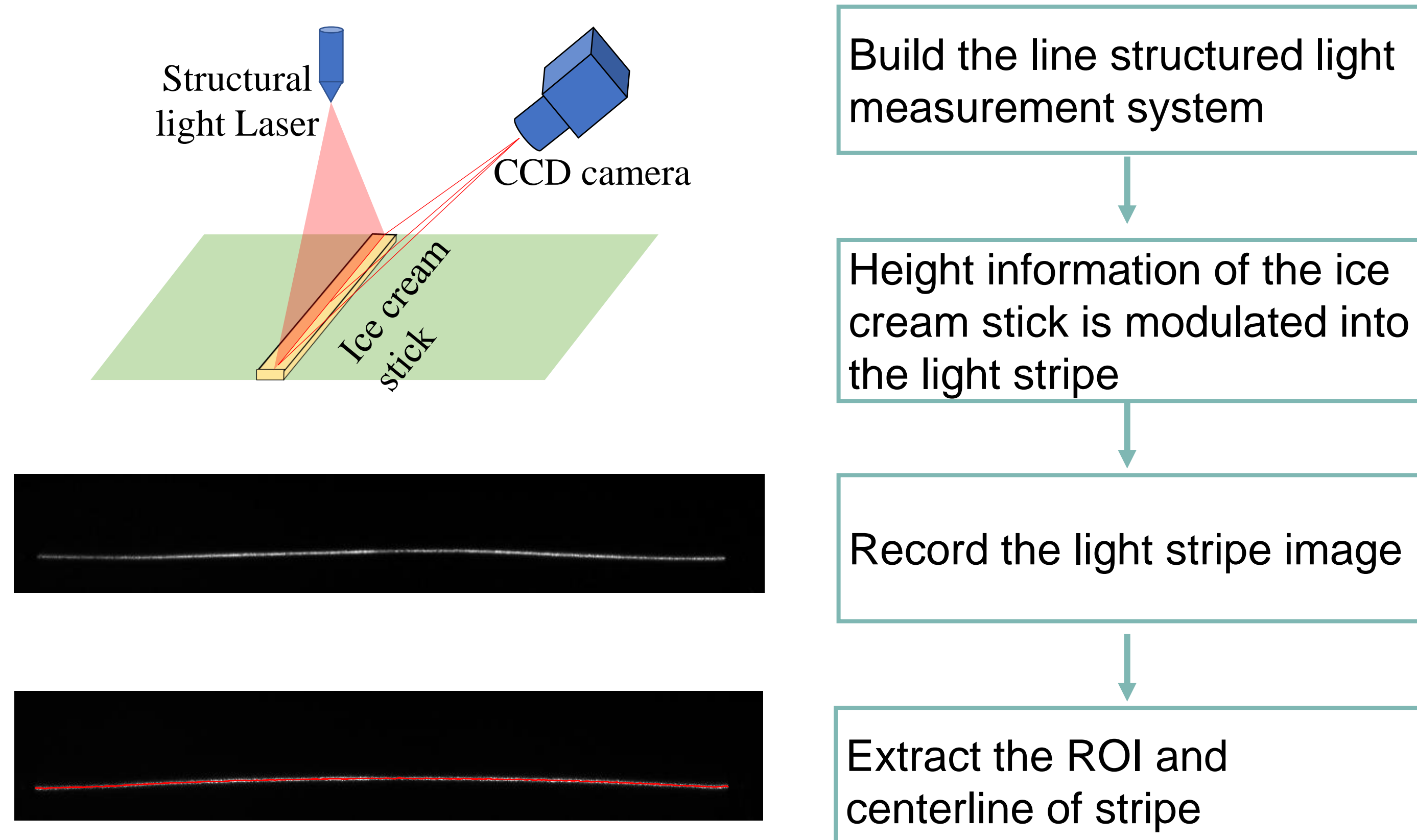
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1. Introduction

- * The ice cream stick is a kind of daily consumables in our life.
- * The profile of qualified product should has plane surface.
- * Due to it is produced with natural wood, so easy to appear bend defect.
- * Bend defects affects product quality and safety problems for consumers.
- * Manual detection technique has low efficiency, low automation, and easily lead to false detection and undetected.
- * Design a vision measurement system with line structured light measurement principle. The recorded light stripe image includes the height information of object surface.
- * Design four kinds of bend features according to the shape characteristics of the light stripe.
- * Introduce the PCA to complete selection of bend feature.

2. Light Stripe Image Acquisition and Processing

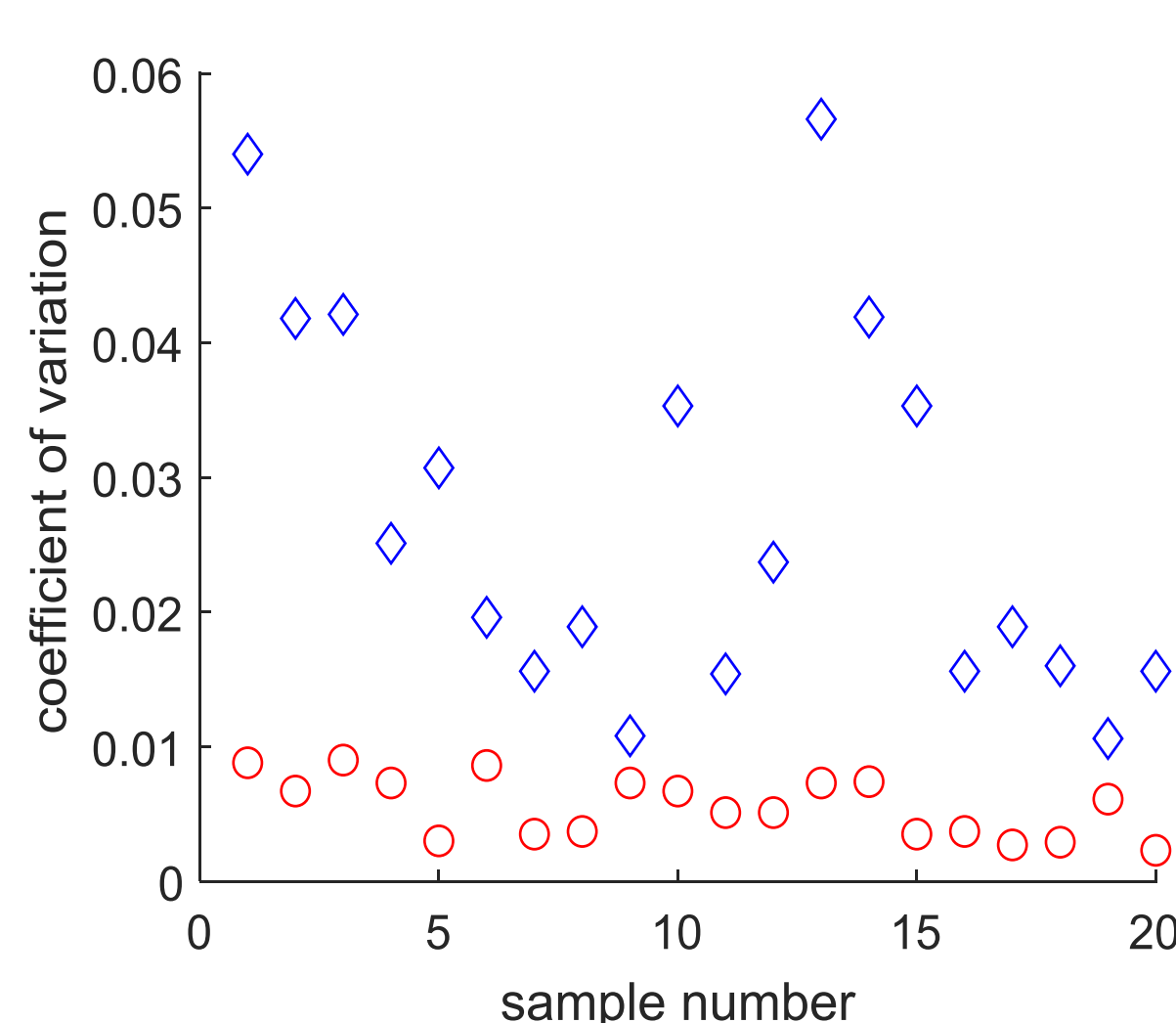


3. Bending Feature Design

Preparation work: Fit the centerline data to line function described by Y' . Then the tilt component is eliminate from light stripe, that is described by D_k .

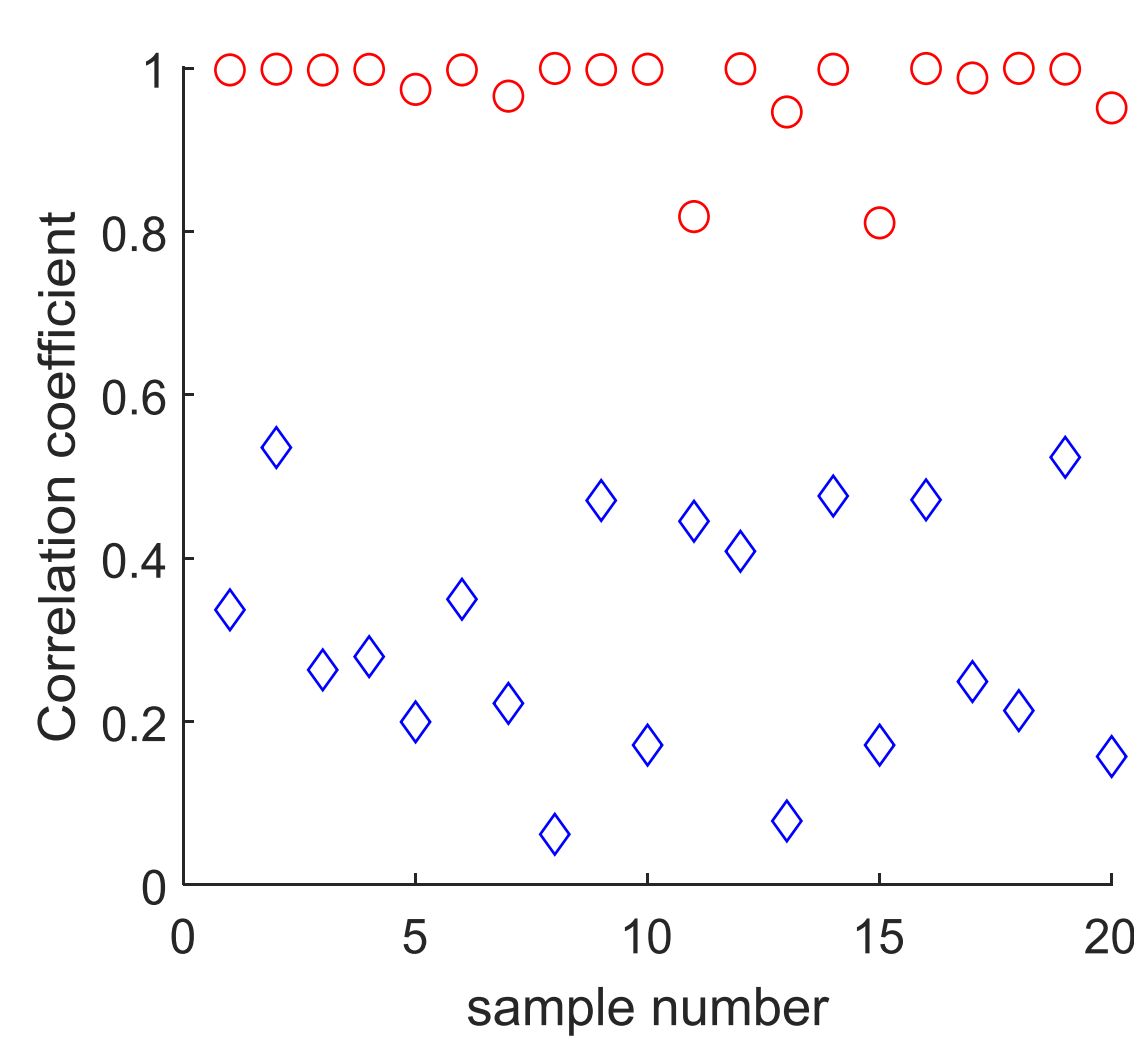
(1) Variation coefficient

$$\delta = \sqrt{\frac{1}{M-1} \sum_{k=1}^M (D_k - \bar{D})^2} / \bar{D}$$



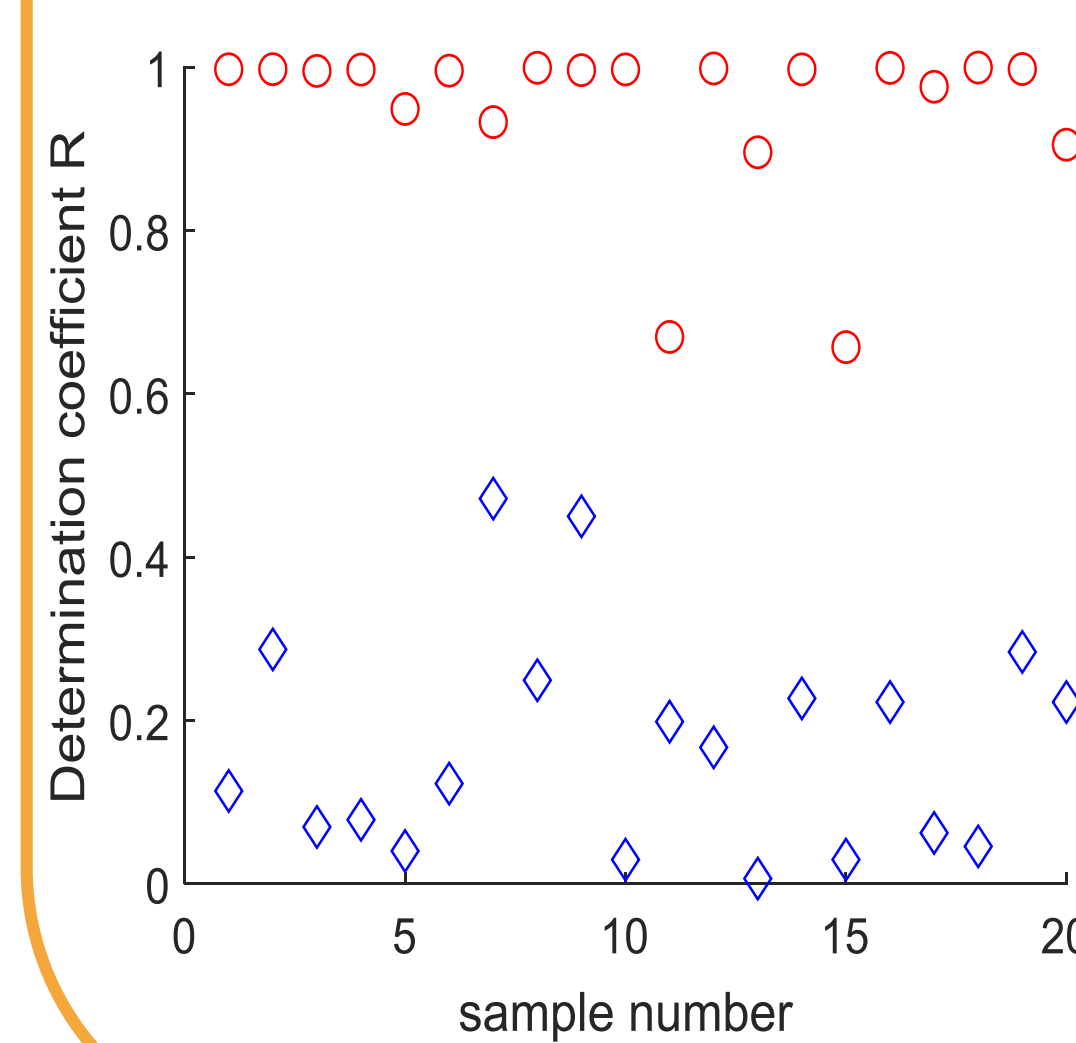
(2) Correlation coefficient

$$\rho = \text{cov}(Y, Y') / (\sigma_Y \cdot \sigma_{Y'})$$



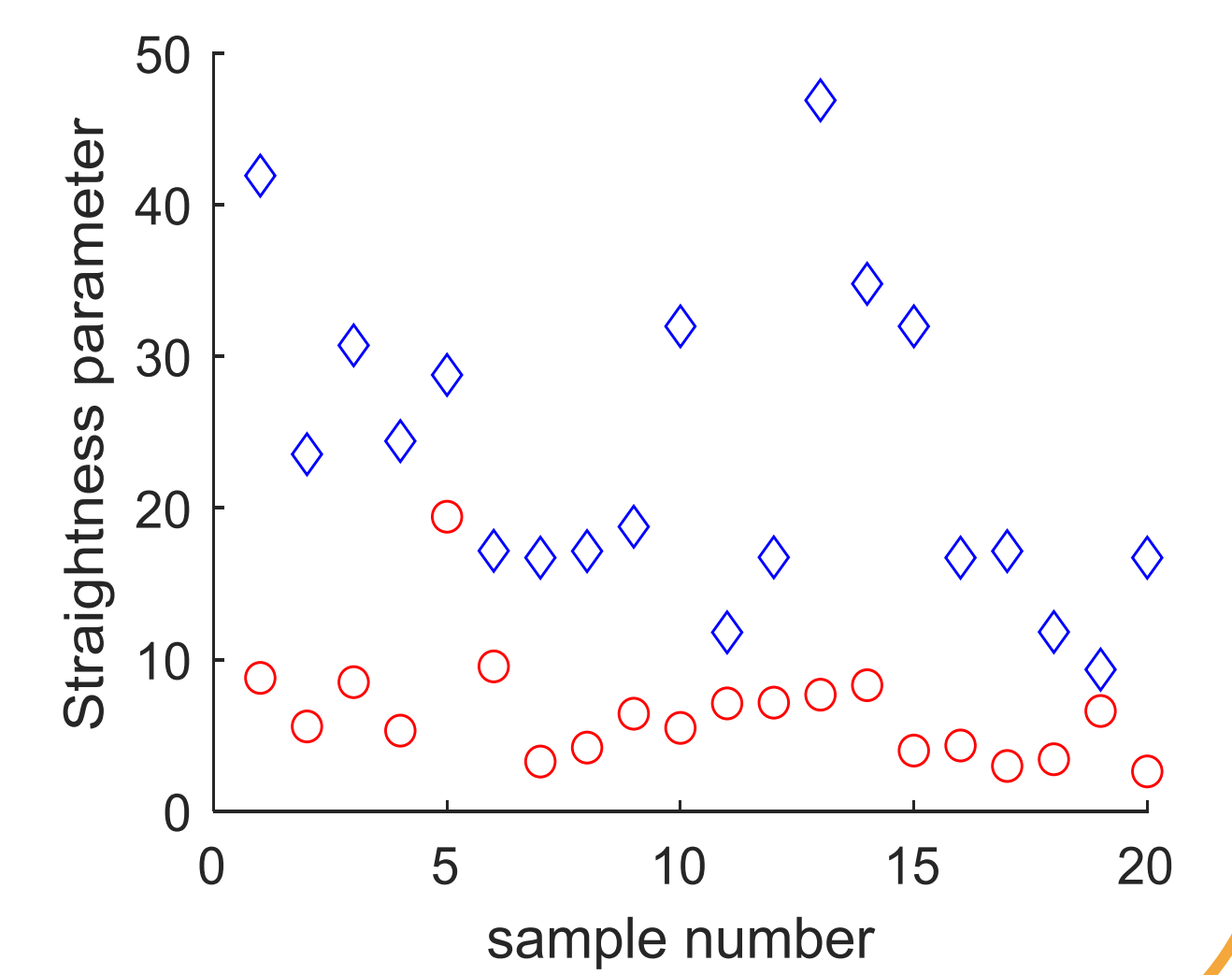
(3) Determination coefficient

$$R^2 = 1 - \frac{\sum_{k=1}^M D_k^2}{\sum_{k=1}^M Y_k^2}$$



(4) Straightness metric

$$\Delta L = \max(Y - Y') - \min(Y - Y')$$



4. PCA-based Feature Selection

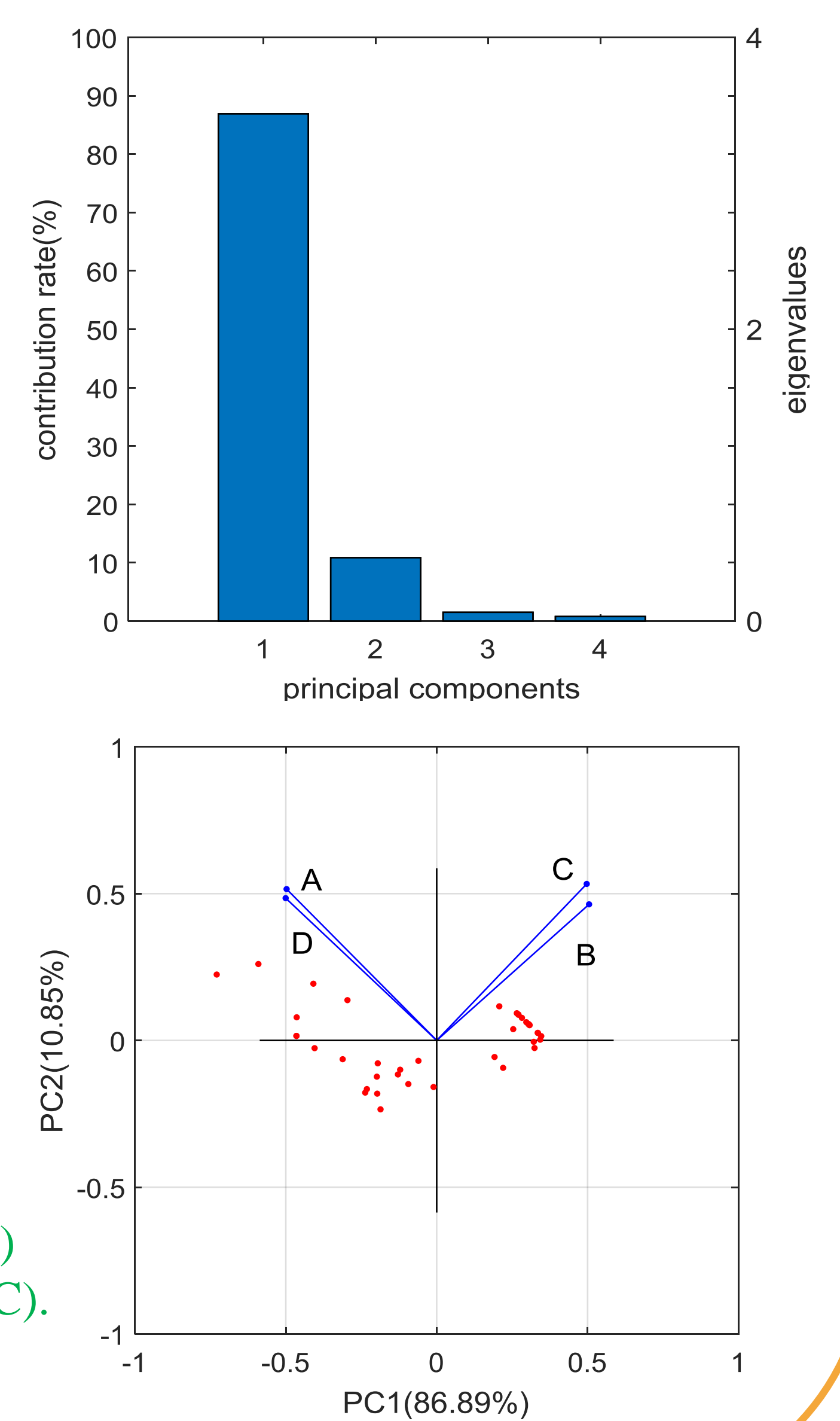
(1) Calculate the bend feature quantities of multiple samples

(2) Combine features quantities into a 2D matrix

(3) Feature extraction based on PCA

(4) Feature selection

Result: the optimal bend classification features are determination coefficient (B) and correlation coefficient (C).



5. Conclusion

- * The light stripe images of ice cream plate surfaces are taken.
- * Four new bend features are designed based on the characteristic of light stripe.
- * The influencing order of the feature parameters is determined which is determination coefficient, correlation coefficient, straightness metric and variation coefficient.
- * provide valuable reference for intelligent detection of bend defects of ice cream stick.

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