# Application of an Improved Intelligent Decision Classification Algorithm in Formative Evaluation

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**Abstract.** In this paper, an algebraic feature intelligent decision-making classification algorithm based on Schmidt orthogonal optimization is constructed. Firstly, Schmidt method is used to orthogonally optimize the classification vectors, then singular value decomposition is applied to the optimized vectors, and finally, Euclidean distance is used to complete the classification of objects. In order to verify the correctness of the algorithm, we apply this intelligent decision classification algorithm to formative evaluation. The experimental results show that the algorithm eliminates the influence of interference information in the evaluation process on the classification accuracy of final evaluation, and greatly improves the accuracy of formative evaluation of teaching.

## Formative Evaluation Mechanism

Formative evaluation is "the evaluation of students'learning process, aiming at confirming students' potential, improving and developing students'learning". The task of formative assessment is to "evaluate students'performance in their daily learning process, their achievements, and the development of their emotions, attitudes and strategies reflected in them." Its purpose is to encourage students to learn, help students effectively regulate their learning process, so that students get a sense of achievement, enhance self-confidence, and cultivate the spirit of cooperation. Formative evaluation not only starts from the needs of the evaluators, but also pays more attention to the needs of the evaluators, the process of learning, the experience of students in learning, the interaction between people, the interaction of various factors in evaluation and the communication between teachers and students. In formative assessment, the teacher's duty is to determine tasks, collect data, discuss with students, infiltrate the teacher's guiding role in discussions, and evaluate with students.

Formative evaluation information is formed in the process of teaching activities, and with the accumulation and enrichment of teaching activities, formative evaluation indicators often include: autonomous learning time, classroom participation, usual practice results, project completion, mid-term and final examination results. We can describe it with a set of vectors.

Let the formative evaluation index vector be:

$A= [ A_1, A_2 ,A_3 ,... A_n ]$ , $A_i = ( a_0,a_1,\ldots,a_n)$

Thereinto, $a_0,a_1,\ldots,a_n$ is indicators of formative assessment.

Conventional eigenvector analysis method. Firstly, feature extraction of vectors and analysis of principal feature vectors are carried out. This method can greatly reduce the dimension of the original feature space and has a high recognition accuracy when classifying information.But when we use algebraic features to classify information, although the eigenvectors of different eigenvalues are necessarily orthogonal, for the same eigenvalue, the corresponding eigenvectors are not necessarily orthogonal, especially when the multiplicity of the selected eigenvalues is large, the angle between the projection base coordinate axes will be very small. At this time, if the classified sample is projected into the feature space at a small angle, it will be easy to be misclassified. Therefore, we introduce Schmidt method, which can rotate the coordinate axis of the selected projection base feature vector, correct the small angle projection base coordinate axis, make it orthogonal, and

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remove the correlation of the selected projection feature vector to improve the accuracy of classification.

### Algebraic Feature Intelligent Decision-making Classification Algorithm Based on Schmidt Optimization

Schmidt method is a method to construct a set of standard orthogonal vectors from a set of linearly independent vectors. Let $\alpha_1, \alpha_2, \cdots, \alpha_r$ be a linear independent column vector in Euclidean space. Now we find a standard orthogonal basis in the dimensional linear subspace generated by this column vector. It is carried out in two steps:

**I. Orthogonalization**

Let $\beta_1 = \alpha_1$

$$\beta_2 = \alpha_2 - \frac{(\alpha_2, \beta_1)}{(\beta_1, \beta_1)}\beta_1$$

$$\beta_3 = \alpha_3 - \frac{(\alpha_3, \beta_1)}{(\beta_1, \beta_1)}\beta_1 - \frac{(\alpha_3, \beta_2)}{(\beta_2, \beta_2)}\beta_2$$

$$\beta_r = \alpha_r - \frac{(\alpha_r, \beta_1)}{(\beta_1, \beta_1)}\beta_1 - \frac{(\alpha_r, \beta_2)}{(\beta_2, \beta_2)}\beta_2 - \cdots - \frac{(\alpha_r, \beta_{r-1})}{(\beta_{r-1}, \beta_{r-1})}\beta_{r-1}$$

It is easy to verify $\beta_1, \beta_2, \cdots, \beta_r$ is orthogonal vector group.

**II. Unitization**

Let $$v_1 = \frac{\beta_1}{\|\beta_1\|}, v_2 = \frac{\beta_2}{\|\beta_2\|}, \cdots, v_r = \frac{\beta_r}{\|\beta_r\|}$$

Obviously, $v_1, v_2, \cdots, v_r$ is a group of standard orthogonal vectors, which is a standard orthogonal basis of subspace $span\{\alpha_1, \alpha_2, \cdots, \alpha_r\}$.

Starting from any set of bases $\alpha_1, \alpha_2, \cdots, \alpha_r$ in the r-dimensional product space, a standard orthogonal basis can be constructed by Schmidt orthogonalization method.

We adopt QR decomposition:

Let $A \in C_n^{m\times n}$ ,then A can be uniquely decomposed into

$A = UR$ or $A = R_1U_1$

Among them, $U, U_1 \in C^{m\times n}$, R is a triangular array in the front line and R1 is a triangular array in the bottom line. (That is, the elements on the main diagonal of R and R1 are all positive).

Let $A \in C_r^{m\times r}$ (called column full rank matrix),then A can be uniquely decomposed into

$A = UR$

Among them, $U \in C_r^{m\times r}$, R is a triangular array of order r.

For Schmidt orthogonal optimized eigenvectors, we use combinatorial algebraic features to improve the accuracy of pattern recognition. In order to further strengthen the classification features of describing objects in practical applications, we first make K-L projection of the vectors to be classified, then transform the analysis vectors into SVD, and then make linear fusion of the transformed eigenvectors to form new feature classification vectors, which are used as criteria for formative evaluation and discrimination. Characteristic vector projection basis change graph after Schmidt Orthogonalization is shown in figure 1.

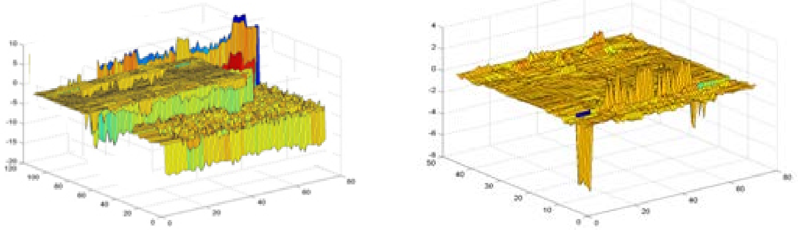

Figure 1. Change of Projection Basis of Eigenvector after Schmidt Orthogonalization

## Singular Value Decomposition Classification Method in Formative Evaluation

### Singular Value Decomposition of Evaluation Vector .

Assuming A∈Rm×n, then there is Orthogonal matrix

$$U=[u_0,u_1,\cdots u_{r-1}]\in R^{m\times n},$$

$$V=[v_0,v_1,\cdots v_{r-1}]\in R^{m\times n}$$

Let $A = \begin{pmatrix}\Sigma & 0\\ 0 & 0\end{pmatrix} V^{T} = \sum_{i=1}^{r}\sigma_i u_i v_i^{T}$

Among above, $\Sigma=diag[\sigma 1, \sigma 2,\cdots, \sigma r]$ and $\sigma 1\geq\sigma 2\geq\ldots\geq\sigma r. >0$, $\sigma 1,\ldots, \sigma r$ is the singular value of the matrix A, r=rank(A) is rank of a matrix A.

The singular value decomposition classification method is shown in the following figure 2.

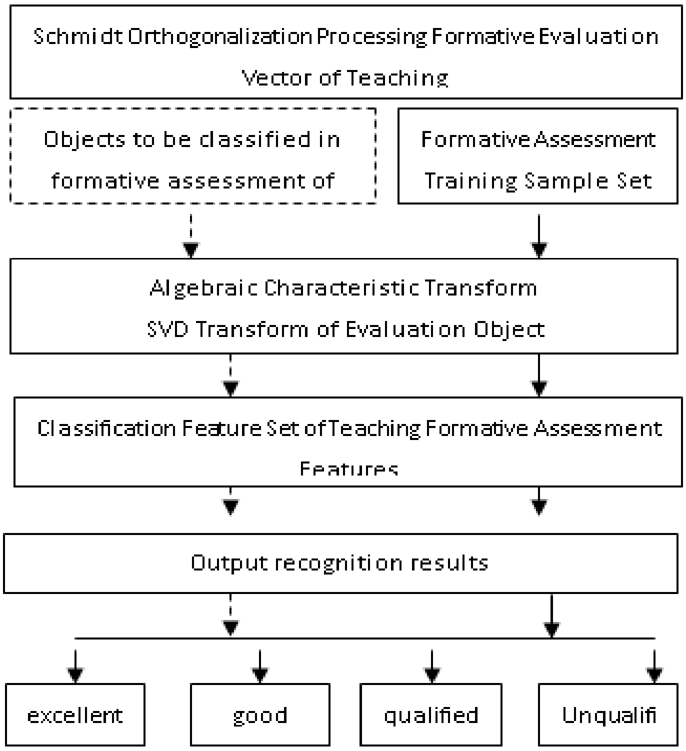


Figure 2. SVD Classification and Discrimination

**Classification and Discrimination Method in Formative Evaluation.**

Classification and discrimination in formative evaluation of teaching is an important part of the final result. There are many methods of feature combination in pattern recognition. In this paper, linear weighting method is used to fuse features, and projection transformation vector is used comprehensively.

The combination of feature vectors based on linear weighting is adopted:

Let the SVD eigenvector be:

$$X = [\, x1, x2\,, x3\ ,\ldots xn\ ] \quad xi = (\, x0,x1,\ldots,xn)$$

Euclidean distance is chosen as the classification method of formative assessment of teaching in the specific discriminant operation. Its definition is as follows:

$$d(i,j) = \sqrt{|x_{i1} - x_{j1}|^2 + |x_{i2} - x_{j2}|^2 + \cdots + |x_{ip} - x_{jp}|^2}$$

The square of Euclidean can be used to compare the differences in the process of vectors, which is helpful to distinguish similar objects to be classified.

## Performance Testing of Algorithmic Model

In order to test and verify the algebraic feature intelligent decision-making classification algorithm based on Schmidt orthogonal optimization, we constructed an auxiliary platform for medical morphology classroom teaching based on mobile terminal. The formative evaluation algorithm of algebraic feature teaching process based on Schmidt orthogonal optimization was designed to provide a real-time interactive lesson for teachers. The classroom teaching assistant tool and platform can record the formative evaluation index of teaching in real time, which provides a carrier for the verification and practice of the algorithm. The Functional Interface of Teaching Formative Assessment System is shown in the following figure 3. The Trend Map of Achievement in Teaching Formative Assessment System is shown in the following figure 4.


Figure 3. Functional Interface of Teaching Formative Assessment System

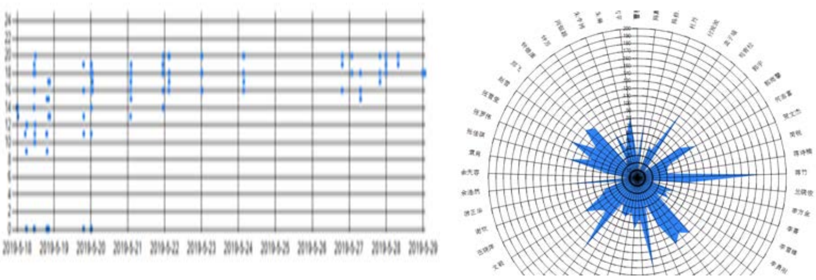

Figure 4. The Trend Map of Achievement in Teaching Formative Assessment System

324 students were evaluated and analyzed systematically. We selected 10 students who are known to be excellent, good, qualified and unqualified in learning evaluation to construct training sample

library, and constructed projection vector library by using the teaching formative evaluation algorithm of algebraic feature analysis model. Then we projected and calculated the formative indexes of other classmates who are not classified.

When the input sample is a trained formative evaluation vector, the system can output classification information accurately, and the classification accuracy is 100%. Experiments on untrained test samples show that the system can output classification matching information.

The algorithm has been tested repeatedly with this system. From the experimental results, it can be seen that the recognition rate increases gradually as the number of training samples increases. This is consistent with people's own visual recognition ability. The system can quickly and uniquely classify all trained formative evaluation information to be classified. The untrained vector to be classified can also be used to classify and discriminate accurately. The experimental results of different test methods are compared as shown in Table 1.

Table 1. Comparison of test results

| Test method | Total number of test samples | Test accuracy number | Test accuracy (%) |
|---|---|---|---|
| **Traditional KL Projection Method** | 324 | 293 | 90．4 |
| **SVD Projection Method** | 324 | 290 | 89．5 |
| **Algebraic Feature Method Based on Schmidt Orthogonal Optimization** | 324 | 319 | 98．5 |

## Conclusions

The algebraic feature intelligent decision-making classification algorithm based on Schmidt orthogonal optimization can make full use of all kinds of evaluation information in formative evaluation process, greatly reduce the dimension of the original feature space, and has a high recognition rate. Therefore, formative evaluation using this algorithm is a better classification and evaluation method.

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