南京航空航天大学

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ENGINEERING TRAINING STRATEGIES UNDER THE CONCEPT OF EDUCATION OF CREATION SCIENCE

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ABSTRACT
The creation education cannot be divorced from the creation practice. The superiority of unfolding the creation education in the engineering training may provide an environment for the creation practice, optimize the structure of the inner qualities of the teaching staff engaged in the creation education, develop the creation capability of the students, explore the raw materials of the creation education from the existing teaching contents, apply the principles and methods of the creation education to the impartment of knowledge and skill, enable the teachers to grasp the essence of the creation education genuinely, set up the appraisal indices for the creation education and so on, being the effective strategies for carrying out the education of the creation science in the engineering training.

KEYWORDS
engineering training; creation education; teaching strategy

As a newly emerging subject, the creation science is gradually receiving increasingly greater emphasis from the institutions of higher school, which have successively opened the courses of the creation science with the aim of enabling the students to make full understanding of the characteristics and regularities of their own creative thoughts, personalities, psychology and some other aspects, skillfully grasp a multiple of creative skills, fully explore their own creative potentialities and finally meet the purpose of improving their abilities of creation through the systematic studies. Nevertheless, for the purpose of realizing this objective, any pure dependence on the studies of the theoretical knowledge in the classroom is not quite enough, we should also lay emphasis on the practice of creation. Only by way of exploring the regularities of creation, tempering the creative thinking and summarizing the methods of creation in the course of practice can we effectively improve the inner qualities of individual creation so as to form the excellent individual qualities of creativity. The practice of creation is suitable for performance in the teachings of specialty practice and various types of extracurricular activities of creation. The engineering training serves as a foundation type link in the practice teaching; and it is necessary to make the engineering training an important position of creation education, penetrate the knowledge of the creation science in the training, enable the students to make creations in the training and undergo training through creation. The unfolding of the creation education in the course of engineering training has a very large aspect of impact and a broad surface of benefits; therefore, it is necessary to construct a teaching mode of engineering training characteristic of the creation education for giving a push to the deep-going and all-round unfolding of the creation education.

1. SUPERIORITY OF UNFOLDING THE CREATION EDUCATION IN THE ENGINEERING TRAINIGN

1.1 TO ENHANCE THE PRACTICALITY OF THE CREATION EDUCATION

Practice is the source of creation. The practical situation of the engineering training will provide abundant raw materials for the creation education; and this doubtlessly helps to transform the theoretical study results of the creation science successfully, enhances the operability and improves the practicality of the creation education. This kind of practicality is mainly manifested in the following two aspects: One is the practicality of the teaching process. The creation education in the course of the engineering training lays particular stress on the combination with practice, which includes the linking of the teaching contents with the creation practice to the greatest possible extent, encouragement of the practical participation on the part of the students in terms of the teaching mode, etc. It is possible to design the teaching contents or raise the subjects in combination with the practical engineering problems so as to increase the

tastefulness, challenges, initiatives and practicality of the study, enable the students to have more chances of getting to work with use of their own hands, thinking participating and training their ability of applying the creative thinking in a flexible way and solving the practical problems with the linking of the acquired theoretical knowledge in practice. The second aspect is related with the laying of particular stress on the practice for the examination of the teaching results. The aim of the creation education is to foster the creative capability of the students. However, capability is a product of practice and may only be manifested through practice[1]. Therefore, the teaching results of the creation education may be objectively reflected in accordance with the students' level of creation and their result of solving various practical problems in the training.

1.2 TO OPTIMIZE THE STRUCTURE OF THE TEACHING STAFF QUALIFIED FOR THE CREATION EDUCATION

The start of the creation education requires a battalion of teachers with the reasonable structure in terms of both knowledge and capability. At present, the teachers who are engaged in the teaching of the courses of the creation education mainly come from the following sources: Teachers of psychology who are engaged in the researches of creative psychology, or teachers of pedagogy who are engaged in the researches of the creation education or those who directly assume the working of teaching after their graduation as undergraduates or postgraduates[2]. Though they have relatively in-depth studies of the creation science, yet they have relatively less contact with the environment of production and practice of scientific researches with somewhat insufficient experience of practice. Nevertheless, the teachers who are engaged in the engineering training can make up this kind of insufficiency. They have been engaged in the frontline of teaching, scientific researches and production for a long time, hence the acquisition of abundant practical experience, strong application capability of getting to work with their own hands and certain accumulation of creative experience. The joining of these teachers or the specialized technicians in the teaching staff doubtlessly injects a new vitality into the battalion of teaching staff for the creation education, changes the phenomena of "inbreeding" of the previous teaching staff battalion, breaks the deadlock of forming a continuous line of succession in the creation education in terms of theory and facilitates the raising and innovation of the academic level.

1.3 TO DEVELOP THE STUDENTS' CAPABILITY OF CREATION IN AN ALL-ROUND WAY

The capabilities of creation acquired by the individuals may be concretely specified into two kinds of capabilities, i.e., explicit capability and implicit capability. The explicit capability such as the faculties of observation, memory, imagination, thinking, self study and so on can be fully tempered and raised in the long-term course of knowledge construction. Yet the implicit capability such as the capabilities of cognition, skill, individual experience in the emotional sphere, intuition, premonition and so on must be acquired through the practical activities by the individuals and mostly developed in an environment which is liberal, free and suitable for creation by way of exerting an edifying influence. The engineering training which is characterized by "personal experience and perception" has a non-substitutive function in the fostering of capabilities compared with the other teaching processes. The atmosphere of practice, the rules and regulations, the teaching concepts, the teacher-student relationship and so on of the Engineering Training Center all contain the factors of creation education. The education of the talented people with the use of the environment, the systems and the management not only facilitates the raising of the students' explicit capability, but also is more favorable to the raising of their implicit capability.

2. STRATEGIES FOR STARTING THE CREATION EDUCATION IN THE ENGINEERING TRAINING

The creation education in the engineering training shall be unfolded with the foot set on its own characteristics; and it is necessary to give full play to the superiority of the practice type teaching, apply the principles and methods of the creation science to the development of the students' creative capabilities and offer guidance to the students in their performance of studies and researches in the engineering training. It is also desirable to lay the particular stress on the acquisition of the cognition type results so as to enable the students to obtain confidence for creation, intensify their creative consciousness and learn the basic methods of creation. In the course of the implementation of the creation education, it is possible to adopt the following strategies:

2.1 TO COMB THE EXISTING TEACHING CONTENTS AND EXPLORE THE CASES OF THE CREATION EDUCATION

The situations of practice in the engineering training contain abundant cases of creation education, which, however, have not been well applied by us. These cases have been often neglected by us, hence they slipped before our eyes, or be "brought out in their entirety"(This is to take the place of the students in terms of thinking). Therefore,

we should comb the existing teaching contents from the angle of the creation science and explore the cases of the creation education from the both positive and negative aspects. The exploration from the positive aspect is just the finding of the "cream". To carry out analyses of the equipment, tools, measuring implements and fixtures on the site of practice are possible to find out the application of many creative skills from the design and manufacture of these equipments, tools, measuring implements and fixtures. For instance, the application of computers to the ordinary machine tools led to the invention of CNC machines; and the creative skill employed herein is the method of transplantation. This practical example can enable the students to better understand the principles and main points as to how to apply the transplantation method, that is to say, the transplantation of the mature technique and particularly the latest result of science and technology into the new sphere "for our usage" so as to enable us to bypass the process of repetitive thinking and repetitive research for the rapid realization of transformations and creation of new things. Meanwhile, it may enable the existing results to prolong their service life, get expanded and be re-created under the new conditions. It is the most efficient and simplest method in the scientific researches; it is also the most frequently used method in the application researches. The similar practical examples are just the crystals of the creative thinking of the predecessors and may serve as the flashlight points for enlightening the wisdom of students. The teachers are expected to find out these points of flash for use in the creation education. The exploration from the negative aspect is just to find out the "drawbacks". Various types of routine machines and equipment with which the students may come into contact in the training are the treasures created by the predecessors through their diligent labor. Compared with the advanced equipment under development, certain drawbacks do exist. Anyhow just these drawbacks have left valuable space for thinking and development for the ensuing innovation. It is necessary to enable the students to realize that innovation is not purely invention and creation, and innovation should also be accompanied with the constant endeavor to strive for perfection. In the course of making perfection for certain things, it also contains abundant contents of innovation. This is because many new problems will be encountered in the course of making perfection for the things. Sometimes, some minor problems will lead to a remarkable innovation. For example, the invention of the automatic positioning function of the electro-spark wire-electrode cutting machine, the high-speed electro-spark drilling machine and so on, are all the results of the endeavor to strive for perfection. Such examples are too numerous to mention one by one. At the same time, Some examples which do not exist in certain teaching materials but are closely related with the training contents shall be introduced from the transformation of the results of scientific researches, the description of the frontline disciplines and the innovation of the engineering and practice so as to enable the contents of training to become the accumulations and concentrations of many years' development of science and technology and enable the students to look afar at the frontline of the scientific development from their standing at the site of training and induce their appetite thirst for the exploration of knowledge and participation in the innovation.

2.2 TO APPLY THE PRINCIPLES AND METHODS OF THE CREATION EDUCATION TO THE IMPARTMENT OF BOTH KNOWLEDGE AND SKILL

First of all, it is necessary to compile the teaching plan and prepare lessons in accordance with the requirement on the creation education. The teaching plan shall clarify the aim and requirement of teaching (both the well-defined knowledge type requirement and the well-defined requirement on the cultivation of the thinking capability) in accordance with the type of teaching(on-the-site class, basic skill training, experiment class or special-subject lecture, etc). How to select the teaching aids, how to design the writings on the blackboard, what kind of teaching methods to be adopted for the particular lesson and so on are all to be set around the education of the creation science. For the purpose of stimulating the students' creative thinking by way of raising questions, it is also necessary to define the requirement on the quality and quantity of the questions to be raised and specify the their proportions in the lecture. Meanwhile, it is expected to list as many answers as possible to be possibly made by the students, analyze the causes of the wrong answers and make corrections on the layer of occurrence of errors in terms of thinking[3].

Secondly, it is necessary to apply various types of creative teaching methods in the course of propagating knowledge and use the vivid and lively teaching methods. Attention shall be paid to the grasping of the following links:

First, to lay emphasis on the method of creative thinking. At the time of describing the operating principles and structure of the equipment, operating methods and the related processing technology and some other types of knowledge, we'd better explain their value of innovation and their significance in the history of scientific development; we should also explain the thinking process or the thinking method related with these summarized or produced results. So far as possible, the thinking process may be demonstrated on the site. For instance, for the students who have received the training of the traditional work types of processing or machining(even better for the students who have received the training of two or more work types), before the start of lecturing on the technology of electro-spark processing, it is possible to use 3-5 minutes to analyze the drawbacks of the traditional processing and list them one by one with the use of the method of drawback listing or convergent thinking and some other creation skills and find out their similarities(for instance, the contact of tool with workpiece, availability of cutting force, etc.), while the said simi-

larities are just the limitations of the traditional processing(the processing mechanism can only be "hardness versus softness"; that is to say, workpiece with lower hardness compared with the tools). Thereafter, discussions are to be followed on the way how to process the materials with higher hardness. Attempts shall be made to raise various types of assumptions. In the course of discussions, the majority of the students adopted the habitual way of thinking or the forward thinking method; that is to say, to carry out analyses, syntheses, judgments and inferences in accordance with the routine way of thinking and raise the solution methods. Otherwise, it was either by way of lowering of the hardness of the materials through heat treatment or by way of developing the tools with higher hardness. At this time, the teacher was expected to offer guidance to the students for making the backward way of thinking or the creative thinking, i.e., whether it was possible to adopt the processing mechanism of "to tackle the hard materials with the use of soft things so as to conquer the hard with the use of the softness"? Afterwards, the process of the invention of the electro-spark processing technology was introduced with explanation, thus enabling the students to have a better understanding of the innovative value of the electro-spark processing technology and its resulting process of thinking. It is necessary to set up such a concept: Compared with the knowledge itself, the thinking method for the production (or study) of the knowledge is equally important and, sometimes, even more important[4].

Second, to stimulate the innovative thinking activities. As for the knowledge to be taught, the teachers shall not always adopt the mode of making positive narration for the introduction, but are expected to construct the "study situation" by way of raising the problem, offering guidance and enlightenment to the students and compelling them to make the conscientious thinking so as to stimulate the thinking activities. For instance, in order to let the students to "comprehend" the scope of application of the electro-spark cutting, the teachers may demonstrate various types of teaching aids such as the conic piece parts with the same shape at the top and at the bottom or with the different shapes at the top and at the bottom, the piece parts containing narrow seams and small holes(with ratio of the depth to the diameter being greater than 10), the piece parts of the die type with the placement of "a small trap"(with no use of thread-running holes but with cut seams), plunger dies (made with hard material), etc. The diversified materials(steel, pure copper, graphite, etc.) used for making the teaching aids would be best. Let the students perform the training of the convergent thinking around the teaching aids and make discussions and analyses on the characteristics of the electro-spark wire-cutting processing.

Third, to promote the interchange of the innovative thinking. The teachers are expected to find ways and means to leave the platform to the students. They shall also lecture on their own understanding or mental gains from the related knowledge in combination with the lecture contents. The purpose is to promote the interchange of thinking so as further cause thinking diffusion or resonance. For instance, at the time of making discussions on the application scope of the electro-spark wire cutting, a blackboard shall be prepared so as to let the students write their result of thinking on the blackboard; then it is possible to obtain two types of answers. One type is the wrong answers, for example, there are cut seams or it is only possible to process the figures drawn with one stroke and so on and so forth. The other type is the correct answers; for instance, it is only possible to make the penetration processing and process the conductors, etc. In the course of such interchanges, the thinking result of one person may be shared by all the students and may even induce new results.

Fourth, to induce the experience of new thinking. The teachers should leave a part of knowledge to be taught to the students for their own learning through personal experience. They should make full use of the way of keeping the students in suspense (that is to say, the students are to be kept anxious for the answers, yet the answers are not to be given immediately). This can stimulate the students to make active thinking activities. It is necessary to choose the comparatively typical contents of knowledge or give certain conditions and materials for making prompt for the way of thinking and let the students search their own thoughts and make summaries. For instance, the teachers may continue to raise the questions in accordance with the result of discussions on the scope of application of the electro-spark wire cutting: How to process the non-conductive materials(to get prepared for the ensuing introduction of the laser processing and ultrasonic processing)? How to process the blind holes (to get prepared for the ensuing introduction of the electro-spark forming processing)? And all such questions. Moreover, the students shall be organized to visualize their imaginations with the flexible use of the frequently used creation skills(such as the brain storm method, associative thinking method, question raising method and so on) for the thinking spread. The students shall be enabled to ponder on the way how to use the existing engineering theories and engineering experience to solve these problems. The teachers shall encourage the students to make active observations on their own initiative, find out the engineering and technical problems existing in various types of equipment and processing methods. In such a way, the students will be further induced to make creative assumptions and write out their reports (and the reports are to be listed in the contents of the training result examination). In this link, the teachers shall lay emphasis on the enlightenment, guidance and interaction and must leave certain thinking space to the students; and it is imperative to distinguish what kind of contents must be lectured by the teachers and what kind of contents must be left to the students for their own study. Besides, it is necessary to classify the students of different layers and leave out the problems of different layers for the different students so as to enable all the students of different layers to have certain gains. This is a kind of enlighten-

ment of innovation by way of making enlightenment of knowledge, the students are enabled to learn the "discovery of knowledge" independently with their own experience and participate in the "creation" of knowledge with great interest.

2.3 TEACHERS MUST STUDY THE CREATION SCIENCE AND HAVE KNOWLEDGE OF THE CONNOTATIONS OF THE CREATION SCIENCE

The unfolding of the creation education have raised the requirement on the teachers in terms of teaching skill and also raised the requirement on the students in terms of their participation in the teaching activities. In the course of teaching, the teachers should not only consider the amount of knowledge to be passed onto the students, but also consider the way how to implement "guidance" around the "study" on the part of the students so as to convert the knowledge to be taught into the actual capabilities grasped by the students. These requirements have, on one hand, urged the teachers to study the theories of the creation science and have knowledge of contents relating to the creation science to be studied, the principles of the creation education and the requirements of the creation education on both the students and teachers, understand the principles and conditions for the development of the creative forces and so on. The teachers shall also study various types of effective ways and means for developing the creative thinking and various types of creative skills for unfolding the inventive activities and grasp the major types among them, because only those teachers who can make applications by themselves may be able to teach the students how to make the applications. On the other hand, the teachers shall also make endeavors in the following several aspects:

(1) To improve the creative thinking capability.

The teachers themselves shall be quick and sensitive in terms of train of thoughts and will always generate new assumptions at any time and work out new ideas; only thus can they be good at exploring the creative factors in the course of teaching and find out the points of innovation in the teaching methods and teaching means. For example, it is necessary to work out some new ideas which may be handled in the light of the concrete circumstances and may be directly geared to the implementation of the innovative thinking training. The purpose is to enable the students to list out as many typical mechanisms as possible which can convert the circular motion into the straight-line motion(such as the crank rocker mechanism of a planer, the ball type feed screw nut couple of the coordinate operating table, etc.). This is useful for training the streamlined way of thinking. This is also useful for training the flexible way of thinking through the analyses of the process of setting up the point of origin and the points of references on the NC machines and useful for training the accurate way of thinking through the exercises of the manual programming and so and so forth.

(2) To improve the capability of creative practice.

The teachers shall be able to solve the practical problems in a creative way. They can not only implement their creative assumptions with the use of their own hands, but also can render assistance to the students to turn their assumptions into the achievements so as to stimulate the students to participate in the creative practice in a self-conscious way. The teachers may enable the students to perceive and share their experience accumulated over a long time through the modes of "small skill", "small extension" and some other ways which may exert a subtle influence, for instance, the skill of choosing the electricity-discharging rules, the skill of reducing the electrode losses, the skill of loading and fixing the formed electrodes, the skill of raising the use rate of the tube electrode, which is used on the high-speed electro-spark drilling machine. etc. The students will acquire the experience and knowledge which belong to them by way of perception of the actual working situations and practice for the realization of their self innovation and the construction of the basis for their own existence and development.

(3) To improve the creative organizing capability.

The teachers shall be able to organize the students into an ideal group which is favorable to the development of creative forces and construct the atmosphere which may pool the collective wisdom and efforts and draw upon all the useful opinions. It is necessary to give full play to the cohesive effect of a working group (i.e., mutual cooperation, mutual stimulation, working hard with one mind and joint struggle) and the complementary effect (i.e., giving play to one another's strong points and making complementarily in terms of capability, knowledge, character, superiority and so on) so as to improve the students' creative forces to the greatest possible degree.

The students shall make joint practice and joint explorations with the teachers in the process of training. In the course of analyzing and solving the problems, they shall perceive the teachers' scientific, rigorous and down-to-the-earth style, their ability of flexible use of knowledge as well as their style and method of both reading and thinking. This has a non-substitutive force of influence and inspiration for enlightening the students' thinking, influencing the students' value orientation, fostering the students' conscientiousness of responsibility and so on.

4 TO SET UP THE APPRAISAL INDICES FOR THE CREATION EDUCATION

The appraisal indices for the creation education shall be introduced into the engineering training quality appraisal stem, which may include two aspects, i.e., the appraisal of the students and the appraisal of the teachers. The appraisal of the students' score of the training may consider the reduction of the proportion of the theoretical examinations and the increase of the checking indices of the report on the innovative thinking training. Similarly, the appraisal of the teaching quality on the part of the teachers shall not only judge whether their lectures are clear and correct or not, whether the application of their teaching methods is appropriate or not, whether their organization and transformation of various teaching links are smooth and natural, etc., but also the teachers should be judged whether they have applied the principles and methods of the creation education in their performance of teaching and whether the quality and quantity of the students' participation in the active thinking activities in the teaching process are high or low, etc.

CONCLUSION

The application of the principles and methods of the creation science in the performance of the engineering training for the creation education may not only benefit the students, but may also benefit the teachers and the Training Center. In the course of teaching, it is possible to form a battalion of teaching staff which is advanced in the educational concept, strong in the research capability, high in the academic level, expert in teaching, familiar with technique, good at management, brave in innovation and enthusiastic in love of the practice teaching. Meanwhile, it can promote the birth of the related teaching materials and items of teaching reform and some other elements of excellent products.

REFERENCES

CAO Yun-sheng. Comparison of the creation teaching with the traditional teaching. Teaching and Management, 2005(8).

ZHOU Hui-jun. Reinforcing the pointedness and efficiency of the innovation education in the colleges and universities. China Higher Education, 2007(3/4).

ZHOU Yao-lie. Creation theory and its application. Hangzhou: Zhejiang University Press, 2000.

LI Jia-zeng. Creation science and training of creative force development. Nanjing: Jiangsu People's Publishing House, 1999.

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基于块区域统计矩的实时运动检测模型*

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摘 要: 为了提高实时运动检测的鲁棒性,利用变异系数对图像序列帧的变化进行块区域统计矩描述,采用共线性检验算法获得变异系数的最大似然估计,然后构建了基于块区域变异系数最大似然比的三帧差分运动检测模型. 实验结果表明,该模型能够较完整地检测到运动物体的轮廓边缘,且对于光照渐变、阴影及背景物体小幅度扰动等都具有较强的鲁棒性.

关键词: 运动检测; 颜色矩; 变异系数; 共线性检验

中图分类号: TP391.4 文献标识码: A

运动检测是计算机视觉中的一个重要环节,其主要目的是根据序列图像将运动物体从背景图像中提取出来. 一般利用连续图像的时间、空间信息对运动区域进行分割,常用的方法有背景减除[1-6]、时间差分[7-9]及光流[10]等. 光流运动检测算法复杂,抗噪性能差,而且如果没有特殊的硬件设施支持,很难用于视频流的实时处理;背景减除运动检测方法一般能够提供最完整的特征数据,但对由于光照及其它外界扰动引起的场景变化过于敏感;时间差分运动检测方法对动态环境具有较强的自适应性,但一般不能完全提取出所有相关的特征像素点,容易产生实体内部的空洞和边缘尾迹现象.

背景的动态变化(如光线的渐变和突变、阴影、摄像头抖动、背景的扰动及噪声干扰等)大大增加了运动检测快速可靠执行的难度. 统计方法以其对各种背景变化具有较强的适应性而被背景减除模型所采用,通常是沿时间轴方向对单像素[1-3]或块区域的变化[4-5]进行统计描述. 与像素级统计分析相比,区域级统计分析对背景变化具有更强的鲁棒性. 目前的研究往往比较注重于时间轴方向而忽视了空间域内的统计分析,且所采用算法大多比较复杂,不能满足实时检测要求.

为了提高实时运动检测的鲁棒性,文中利用变异系数对图像序列帧进行块区域统计描述,构建了基于变异系数最大似然比(MLR)的三帧差分实时检测模型. 实验结果表明,该模型不仅是敏感的活动边缘探测器,而且对于光照渐变、阴影及背景物体小幅度扰动等都具有较强的鲁棒性,能有效地消除尾迹和空洞现象.

1 序列帧的块区域统计描述

在连续图像序列的相邻帧间,时间差分运动检测方法采用基于像素的时间差分并且阈值化来提取出图像的运动区域. Lipton等[7]利用两帧差分方法从实际视频图像中检测出运动目标,进而用于目标的分类与跟踪;文献[8]中利用三帧差分代替两帧差分来判断当前像素点 $I_n(x, y)$ 是否运动,即对于阈值 $T_n(x, y)$,如果满足 $|I_n(x, y) - I_{n-1}(x, y)| > T_n(x, y)$ 和 $|I_n(x, y) - I_{n-2}(x, y)| > T_n(x, y)$,则认为该点为移动点.

将待检测场景图像等分为 $M \times N$ 个大小均为 $n \times n$(像素)的子窗口,采用颜色矩[11]对每个窗口进行颜色空间的统计描述. 由于三阶矩对噪声过于敏感,因此文中只采用其中的一阶矩和二阶矩:

$$\begin{cases} \mu_k = \dfrac{1}{n^2}\sum_{i=1}^{n}\sum_{j=1}^{n} P_k(i, j) \\ \sigma_k = \left(\dfrac{1}{n^2}\sum_{i=1}^{n}\sum_{j=1}^{n}(P_k(i, j) - \mu_k)^2\right)^{\frac{1}{2}} \end{cases} \tag{1}$$

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式中: $P_k(i, j)$为 $n \times n$子窗口中像素点 (i, j)的第 k个颜色分量. 颜色空间采用对阴影具有较好鲁棒性的 (r, g, s)色彩模型[1]:

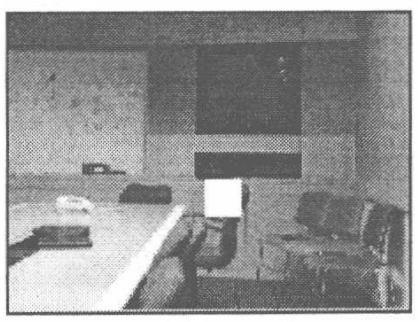
$$\begin{cases} r = R/(R+G+B) \\ g = G/(R+G+B) \\ s = (R+G+B)/3 \end{cases} \tag{2}$$

式中: r、g为色度; s为光强度.

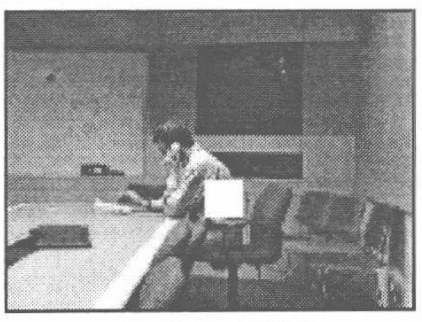
实验结果表明, s分量的颜色矩 μ_s、σ_s对物体边缘进入窗口的反应较敏感. σ_s对光照的均匀变化、阴影遮挡甚至背景物体小幅度扰动等都具有较强的鲁棒性,并对噪声有一定的抑制作用. 在采样窗口未被覆盖时,均值与标准差的变化比较平稳;在移动物体进入采样窗口时,标准差比均值有更明显的阶跃,但由于采样区域被覆盖后,像素点 s分量的均值比背景像素点的高,导致二者在阶跃后 (移动物体进入)没有明显的回落.为使所选取的统计度量能够在块区域被运动物体完全覆盖后,基本不受物体小幅度摆动的影响,即存在一个明显的回落,鉴于 μ_s与 σ_s在描述块区域变化时具有一定程度的趋同性,文中采用 s分量变异系数 C_s来进行块区域的统计描述:

$$C_s = \sigma_s/\mu_s \times 100\% \tag{3}$$

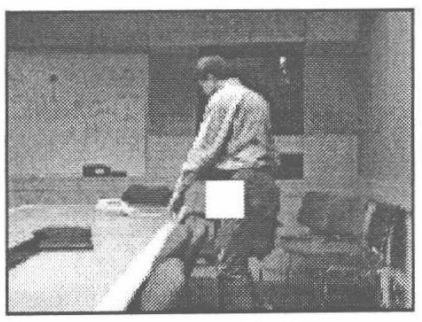
当运动物体进入或移出块区域时,变异系数的变化比较显著;当块区域被覆盖后,物体在原位置小幅度摆动时,变异系数相对稳定,几乎仍然维持在块区域被覆盖前的水平. 图 1所示序列帧采样区域 (图中 15 ×15的白色矩形) s分量变异系数 C_s的变化如图 2所示.



(a) 第1~48帧



(b) 第49~273帧



(c) 第274~350帧

图 1 序列帧

Fig 1 Frame sequences

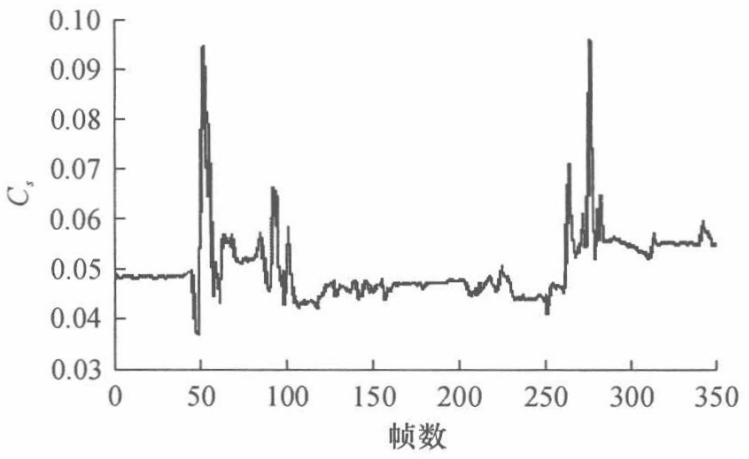


图 2 采样区域 C_s的变化曲线

Fig 2 Variation curve of C_s of the sampling block for component

2 基于变异系数最大似然比的差分检测模型

运动检测模型必须考虑噪声及其它外界干扰以增强模型的鲁棒性. 实际应用中,式 (3)中理想信号与噪声的均值和方差往往均为未知量,这给变异系数的精确表达带来了困难. 文中采用共线性检验方法[12]来获得变异系数 C的最大似然估计.

设连续两帧序号为 m与 $m+1$,分别使用各自子窗口的一阶及二阶颜色矩来构造向量:

$$\begin{cases} \mathrm{X}_m = (\mu_m, \sigma_m)^{\mathrm{T}} \\ \mathrm{X}_{m+1} = (\mu_{m+1}, \sigma_{m+1})^{\mathrm{T}} \end{cases} \tag{4}$$

理想情况 (零噪声、零干扰)下,对于零假设 H_0, X_m与 X_{m+1}相互平行. X_m与 X_{m+1}不共线的原因在于噪声的干扰或子窗口内物理表面的变化. 综合考虑这些因素,在信号与噪声的均值、方差均未知的情况下,通过对 X_m与 X_{m+1}的共线性检验来给出第 $m+1$帧变异系数的最大似然估计.

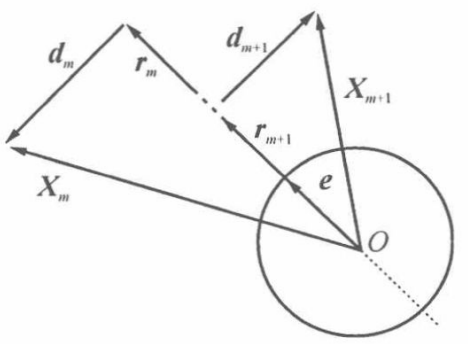


图 3 C_{m+1}的最大似然估计

Fig 3 Maximum likelihood estimation of C_{m+1}

如图 3所示,设 $\mathrm{e} = (e_x, e_y)$为二维单位向量, r_m、r_{m+1}分别为 X_m与 X_{m+1}在 e上的投影,且 $\mathrm{d}_m = \mathrm{X}_m - \mathrm{r}_m$, $\mathrm{d}_{m+1} = \mathrm{X}_{m+1} - \mathrm{r}_{m+1}$. 如果存在单位向量 $\mathrm{e}' = (e_x', e_y')$,使得 d_m与 d_{m+1}的 Euclidean范数 D^2最小,则视投影向量 r_m、r_{m+1}分别为 X_m与 X_{m+1}的最大似然估计,而 C_{m+1}的最大似然估计为 $\hat{C}_{m+1} = e_y'/e_x'$.

对于 d_m,有

$$\| d_m \|_2^2 = \| X_m \|_2^2 - \| r_m \|_2^2 \quad (5)$$

设 X_m 与 r_m 的夹角为 ϕ_m,则

$$\| r_m \|_2 = | \| X_m \|_2 \cos\phi_m | = | X_m^T e | \quad (6)$$

由式 (5)、(6)可得:

$$\| d_m \|_2^2 = \| X_m \|_2^2 - e^T X_m X_m^T e,$$

同理可得 $\| d_{m+1} \|_2^2$,则

$$D^2 = \| X_m \|_2^2 + \| X_{m+1} \|_2^2 - e^T (X_m X_m^T + X_{m+1} X_{m+1}^T) e \quad (7)$$

定义矩阵 $A = \left[X_m^T \quad X_{m+1}^T \right]^T$,则式 (7)可写为

$$D^2 = \| X_m \|_2^2 + \| X_{m+1} \|_2^2 - e^T A^T A e \quad (8)$$

欲得到 D^2 的最小值,只需式 (8)中的 $e^T A^T A e$ 项取最大值. 这样问题转化为矩阵 $A^T A$ 的特征值问题,即若 e是 $e^T A^T A e$的一个极值点,则必定满足:

$$A^T A e = e \quad (9)$$

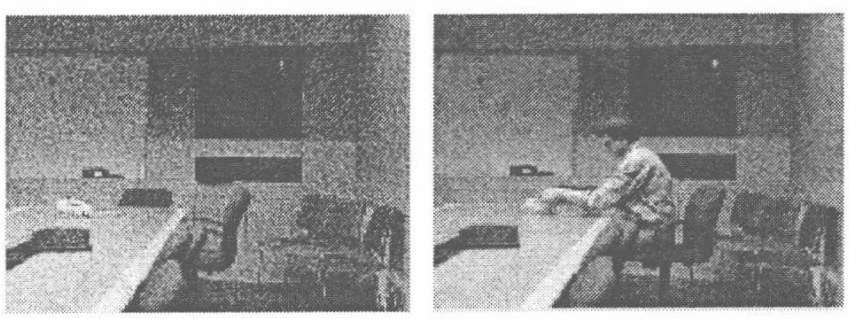
式中: 为 2 ×2实对称矩阵 $A^T A$ 的特征值; $A^T A$ 的最大秩为 2,只有两个非零特征值. 容易证明,在 $e^T e = 1$的条件下, $e^T A^T A e$的极大值对应着 $A^T A$ 的最大特征值 $_{max}$. 式 (9)可进一步表示为

$$\begin{bmatrix} \mu_m^2 + \mu_{m+1}^2 & \mu_m \sigma_m + \mu_{m+1} \sigma_{m+1} \\ \mu_m \sigma_m + \mu_{m+1} \sigma_{m+1} & \sigma_m^2 + \sigma_{m+1}^2 \end{bmatrix} \begin{bmatrix} e_x \\ e_y \end{bmatrix} = \max \begin{bmatrix} e_x \\ e_y \end{bmatrix}.$$

从而得到 C_{m+1}的最大似然估计为

$$\hat{C}_{m+1} = \frac{e_y}{e_x} = \frac{\max - (\mu_m^2 + \mu_{m+1}^2)}{\mu_m \sigma_m + \mu_{m+1} \sigma_{m+1}}.$$

对图 1序列帧叠加了零均值 Gauss白噪声,结果见图 4,叠加 Gauss白噪声后某采样窗口的变异系数 C及其最大似然估计 $\hat{C}$曲线见图 5.



(a) 第1~48帧　　(b) 第49~273帧

图 4　叠加 Gauss白噪声后的序列帧

Fig 4　Frame sequences added with Gauss white noise

图 5表明,C的最大似然估计 $\hat{C}$不但有效地抑制了噪声,而且其曲线更为平滑. 实验中还发现,与 $\hat{C}$值相比,相邻序列帧对应窗口的 $\hat{C}$的比值更能客观地反映当前窗口的运动状态. 该比值对移动物体的边缘进入或离开窗口的情况反应最为敏感,可以说是敏感而可靠的活动边缘探测器.

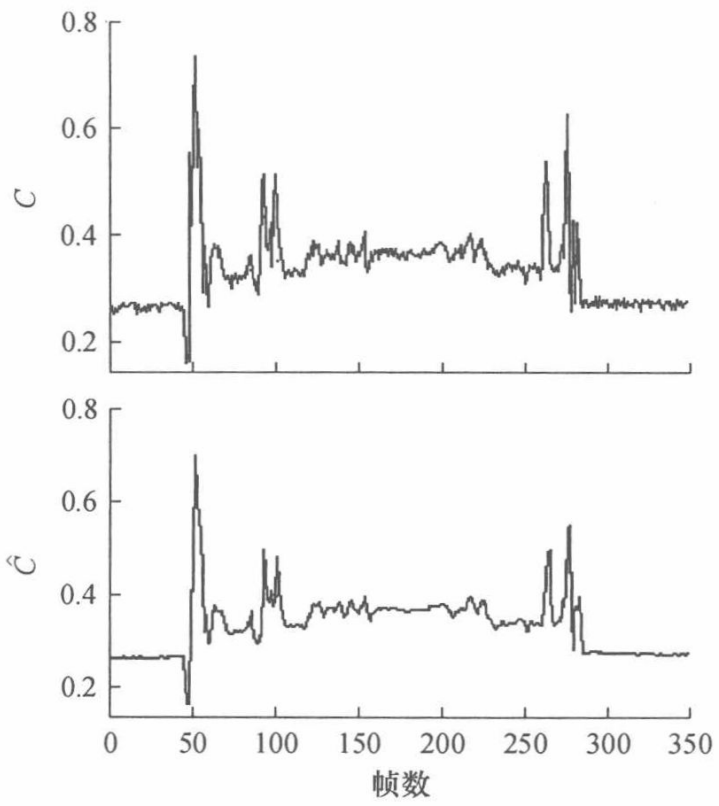


图 5　叠加 Gauss白噪声后某采样窗口的 C和 $\hat{C}$曲线

Fig 5　C and $\hat{C}$ curves of one sampling window after adding Gauss white noise

为便于说明,文中设相邻的第 m 与第 $m+1$帧的子窗口为 W,则其 $\hat{C}$的比值为

$$M_W(m+1, m) = \hat{C}_{m+1} / \hat{C}_m.$$

图 1序列帧对应采样区域的 M曲线见图 6从图 6中知,在移动物体 (边缘)进入或离开采样窗口时,M信号的阶跃最为明显 (M大于 1.5).

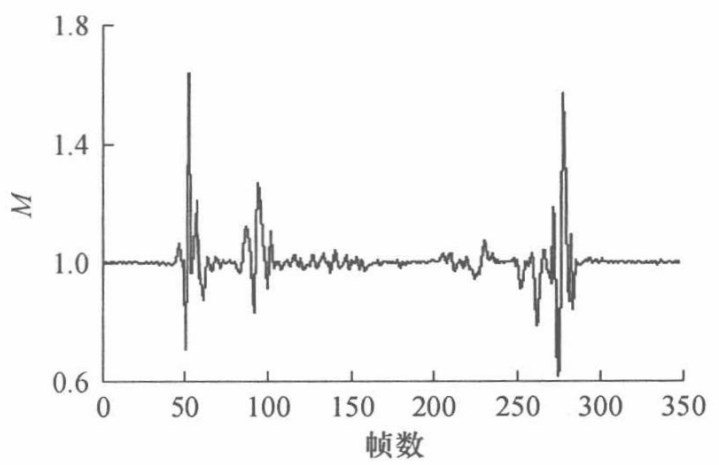


图 6　某采样窗口的 M曲线

Fig 6　M curve of one sampling window

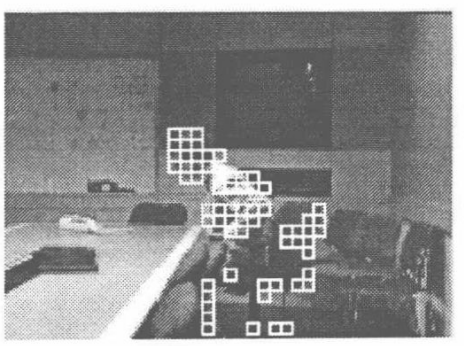


图 7　MLR模型的检测结果

Fig 7　Detection results of the MLR model