4. Primary discharge phase – the muscles performs an isotonic eccentric muscle contraction (contracture).

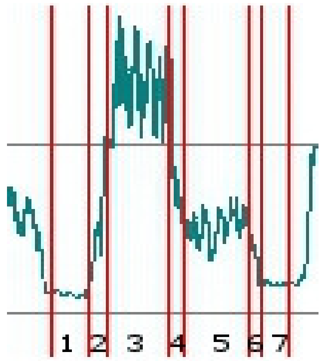

Fig.8. The muscles contraction phases

5. Motion stabilization phase - in this phase the muscle performs supplementary work (compared to the effort during the primary discharge phase) to provide precision to the movement. Although this phase presents a constant step on the discharge stage, however due to the elastic properties of muscles and tendons, mechanically speaking, we don't have take into account a shock. The muscle activity is isometric, visually indistinguishable (also due to muscle elasticity);
6. Secondary discharge phase – the muscle performs an isotonic, eccentric muscle contraction (contracture);
7. Phase of inactivity – the muscle relaxes after the exercise.

CONCLUSIONS

The third stage of experimental loading provides a better delineation of the muscle contraction phases, due to the fact that the muscle load is applied in dynamic terms. When performing research, identification of periods where the muscle is active can allow for correlation between external factors and muscle activity. Statistical methods might help us identifying the muscles activity.

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A MODEL FOR STUDYING THE HUMAN UPPER LIMB KINEMATICS

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Abstract

The paper presents a virtual model for studying the kinematics of the upper limb. The model was designed using Catia features, that provide also a kinematic module, tailor made for kinematic analysis. The displacement of the upper limb muscles, their velocities and accelerations are determined using that module. We were also able to input the motion law and to study two different motion, that are part of the daily activities or that are used in training.

***Key-words**: biomechanics, upper limb, model, kinematics, muscles*

INTRODUCTION. CURRENT STATUS

The main objective of this work is to develop a virtual biomechanical model to study the kinematics main arm muscles: biceps, triceps and brachialis.

The complexity of hand’s osteoarticular system renders the kinematic modeling as a challenge. This complexity requires researchers to develop simplifying assumptions to facilitate the understanding and the proper management of models [Bullock MI, 2012]. However, assumptions have important implications in the accuracy of the final model [Cuevas VF, 2003]. This analysis focuses on the the human upper limb kinematics analysis and simplifying assumptions are used in a wide range of models described in literature as follows: descriptions on hand biomechanics [Brand PW, 1999], kinematic models for studying neuromuscular control [Cuevas VF, 2005], analysis techniques for identifying gestures [Pavlovic VI, 1997, Erol A., 2007], analysis of finger movements to develop robot manipulators with multiple fingers [Zhaojie J., 2008] the analysis of the vast field of the human hand models [Sancho JL, 2011], methods for measuring the active area of the hand for rehabilitation or ergonomics field [Kuo LC, 2009].

MODEL DESIGN

Based on anatomical considerations [Cioroiu GS, 2006, Nenciu G., 2005, Ifrim M., 2005], the kinematic model of the human upper limb has been designed using features from CATIA software. Thus, the modules Mechanical Design> Assembly Design and Digital Mockup> DMU Kinematics had provided great opportunities for a proper design of the human upper limb.

Bones modeling

Because the aim of our paper is to analyze the kinematics of human upper limb using a mechanical model, we had to consider that for this purpose, the geometry of bones is not significant. It only will increase the time for computing the kinematics [Gingins, P., 1996]. Using the conventions from theory of mechanisms and machines, we have considered the bones as kinematic elements connected by joints.

Joints modeling

The human upper limb joints are modeled using rotational kinematic couplings [Dragulescu D., 2005], as follows:

– The shoulder joint is modeled by superposition of two rotational kinematic couplings that will allow the flexion-extension and abduction-adduction movements;

– The elbow joint is modeled by two rotational kinematic couplings that will allow the flexion-extension and pronation-supination movements;

– The wrist joint is modeled using a rotational joint that will allow the flexion-extension movement.

An important issue is to model the rotation axis of each joint, according the the real motions of the human upper limb. In order to achieve that task, we have take into account the following aspects:

1. The movement performed in the joint is an anatomically normal motion;
2. The distance between articulated surfaces must be constant during the motion.

Muscles modeling

In order to analyze the muscle contraction in terms of kinematics, the muscle is modeled through two hubs, corresponding to the proximal (muscle origin) and distal (insertion point of the muscle) end of the muscle. These two hubs are translating relative to one another.

The link between the muscle and the bone is modeled through an universal joint (fig. 1, B), Because muscle axis not in plane motion [Surowiec M., 2007], the relationship between muscle and bone is done through a cardan joints, part B (fig. 1).

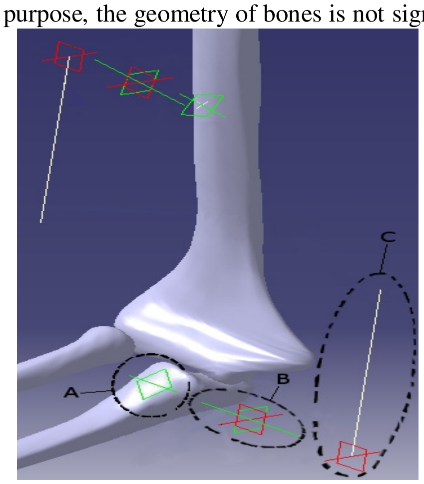
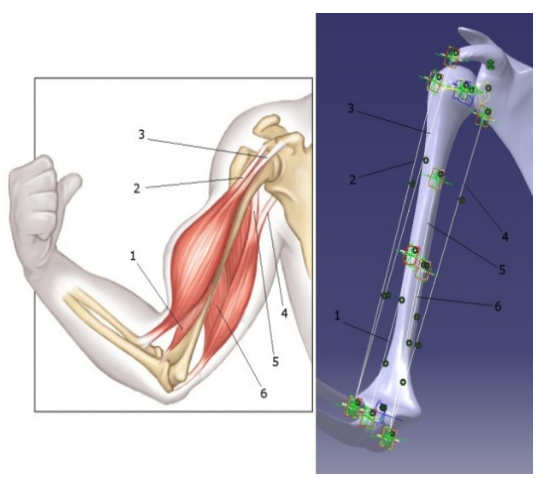


Fig.1. the link between the muscle and the bone



a) b)

Fig.2. The muscular fibbers

The kinematic model (fig.2.a) comprises six muscular fibbers corresponding to the following muscles:
Fiber 1 corresponding to the brachial;
Fiber 2 corresponding to the long head of biceps brachii muscle;
Fiber 3 corresponding to the short head of biceps brachii muscle
Fiber 4 corresponding to the median of triceps brachii muscle
Fiber 5 corresponding to the lateral head of triceps brachii muscle
Fiber 6 corresponding to the long head of triceps brachii muscle

Bio-mechanical system simulation

We have managed to modeling and simulate the upper limb bio-mechanical structure using the feature provided by Catia: Digital Mockup > DMU Kinematics.

The five DOF model allows five rotations corresponding to the rotations of the shoulder, the elbow and the wrist.

In order to get a more natural motion of the model of the human upper limb, we have chosen a motion law that must fulfil two important requirements, consisting of zero velocities and accelerations at the end of the path [Năstase A., 2011]. Thus, these requirements can be written as follows:

$$\begin{cases} y(0)=0;\ y'(0)=0;\ y''(0)=0 \\ y(1)=0;\ y'(1)=0;\ y''(1)=0 \end{cases} \quad (1)$$

These requirements are met by a fifth degree polynomial function, which graphical representation is shown in fig. 3:

$$y(x)=6x^5-5x^4+10x^3 \quad (2)$$

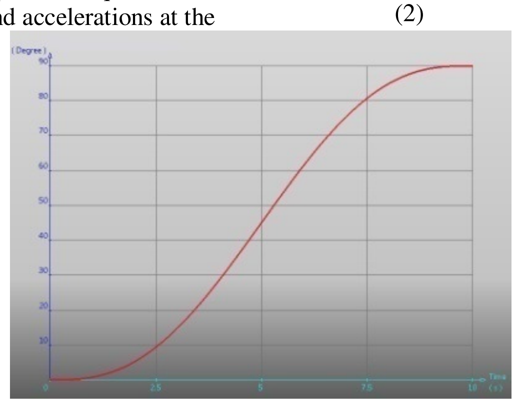


Fig.3. Graphical representation of the fifth degree polynomial function

RESULTS

For kinematic study of anterior muscle of human upper limb (biceps and brachialis) the model will perform a flexion-extension motion of the forearm (fig. 4).

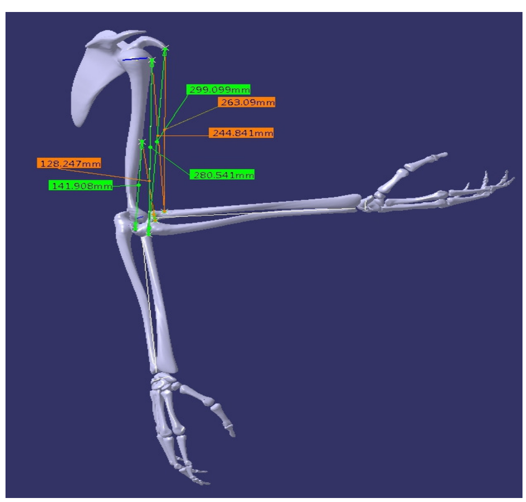


Fig.4. The flexion-extension motion of the forearm

During that motion, the muscles perform an isotonic concentric contraction. This motion is considered to be one of the most frequent motions of the daily activities, thus it is important for rehabilitation exercises and training activities.

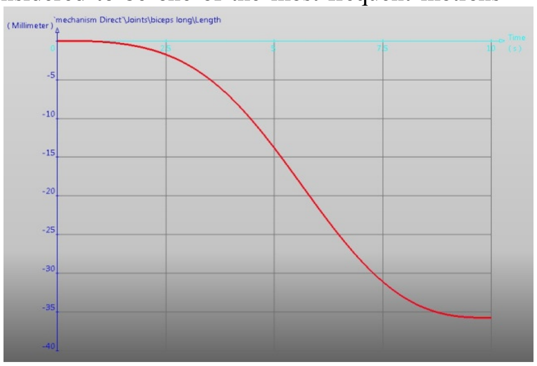


Fig.5. Long head of biceps displacement

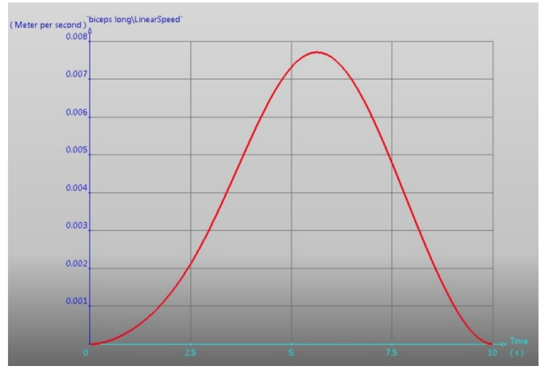


Fig.6. Long head of biceps linear velocity

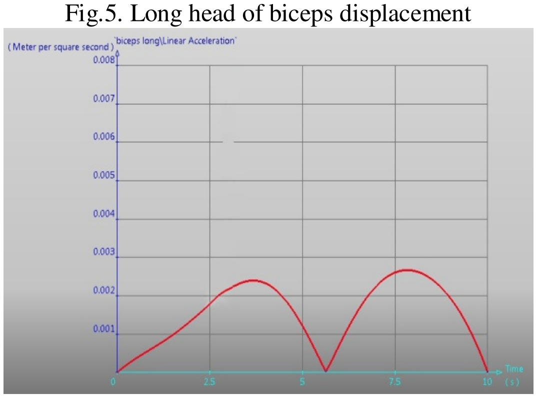


Fig.7. Long head of biceps linear acceleration

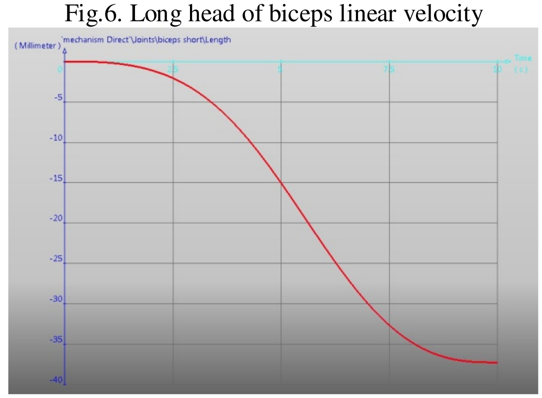


Fig.8. Short head of biceps displacement

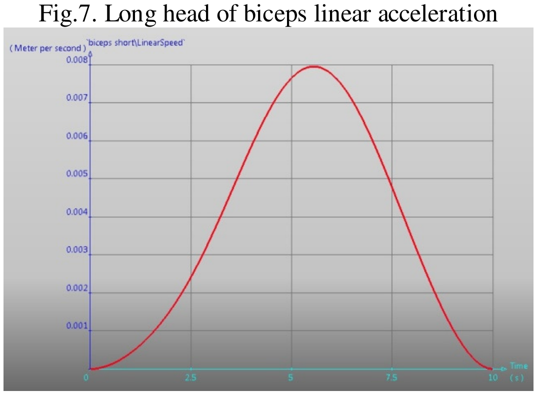


Fig.9. Short head of biceps linear velocity

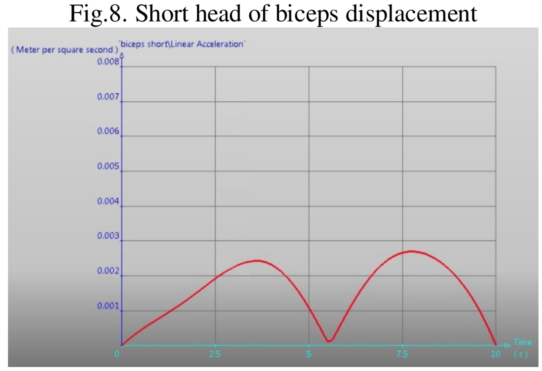


Fig.10. Short head of biceps linear acceleration

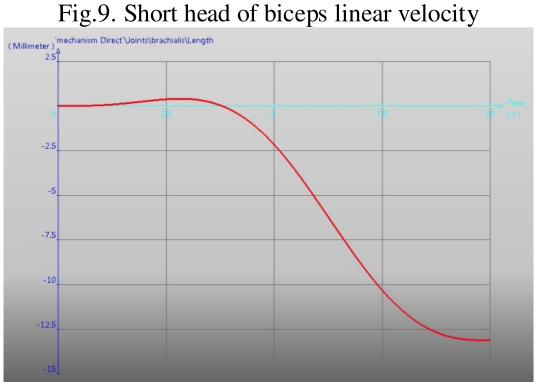


Fig.11. Brachialis displacement

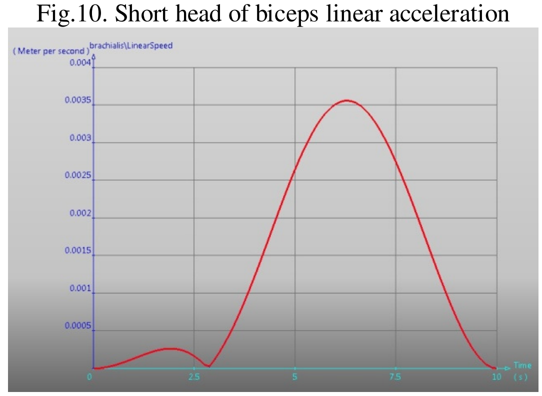


Fig.12. Brachialis linear velocity

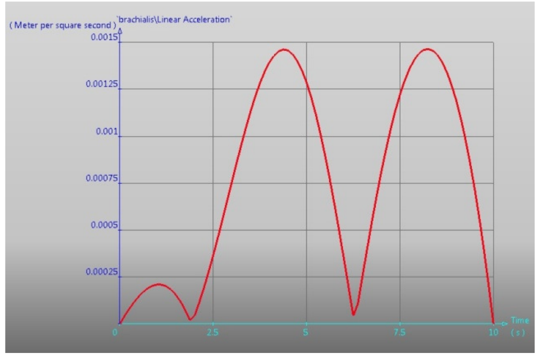


Fig.13. Brachialis linear acceleration

In order to analyze the kinematics of the posterior muscle of the human upper limb (the triceps) the bio-mechanical model will perform a push-up motion (fig.14).

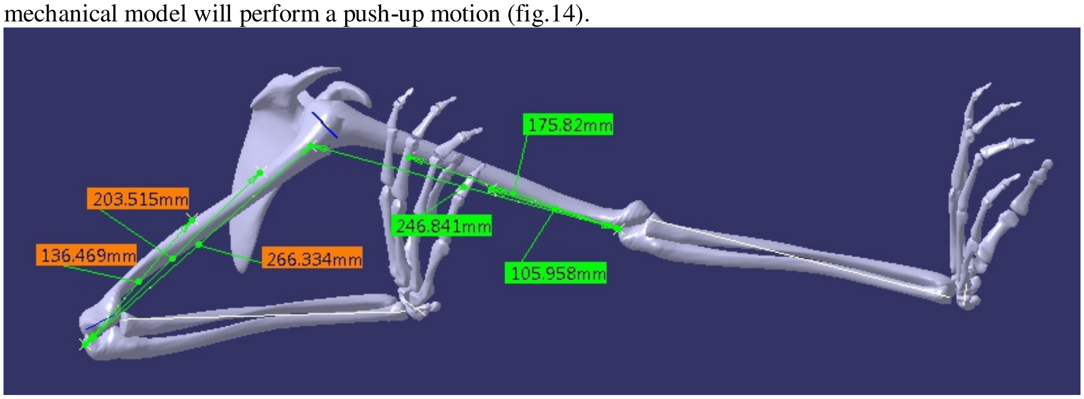


Fig.14. Push up motion

During that motion, the muscles perform an isotonic eccentric contraction. That is one of the most frequent motions during daily activities, medical exercises, medical exercises for rehabilitations of disabilities individuals, but most of all for training purposes.

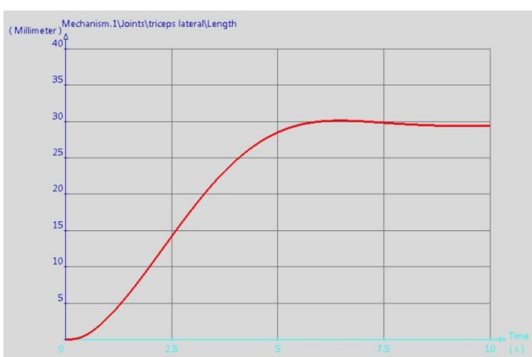


Fig.15. Lateral head triceps displacement

Fig.16. Lateral head triceps velocity

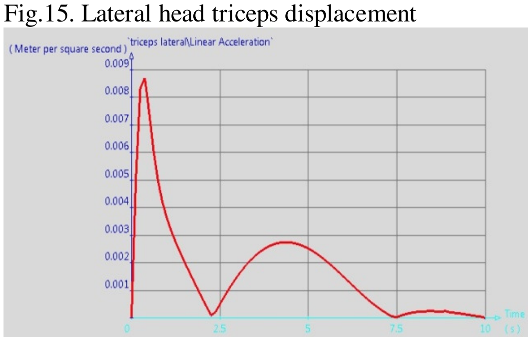


Fig.17. Lateral head triceps acceleration

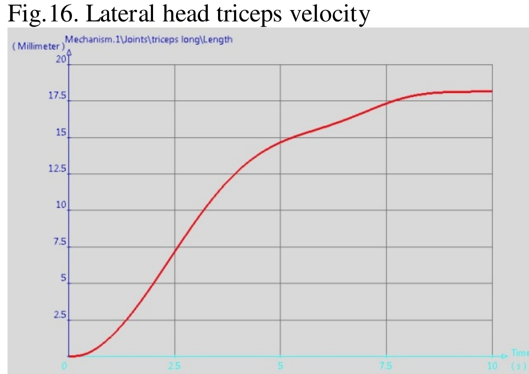


Fig.18. Long head triceps displacement

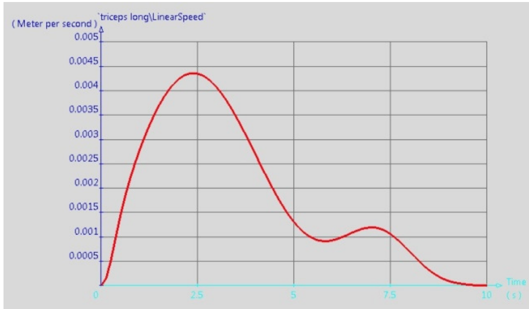


Fig.19. Long head triceps velocity

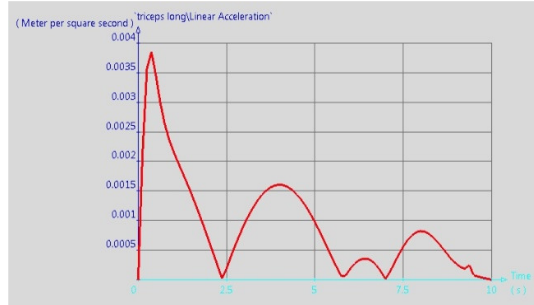


Fig.20. Long head triceps acceleration

Fig.21. Medial head triceps displacement

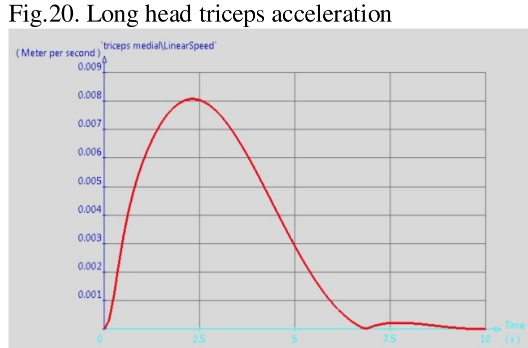


Fig.22. Medial head triceps velocity

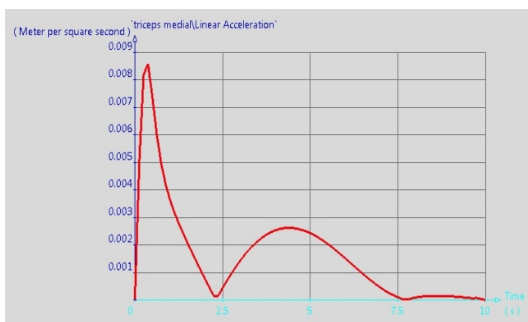


Fig.23. Medial head triceps acceleration

CONCLUSIONS

During the flexion-extension movement of arm muscles, long head biceps, biceps short head and brachialis bear a shortening of 35.70mm, 36.01mm, 13.66mm respectively. The percentage of the shortening of muscles is 12.72%, 12.04% and 9.62%.

In the push up movement of the upper limb, the long head triceps, the medial and lateral head triceps bear an elongation of 19.49mm, 27.69mm, 30.51mm respectively. The percentage elongation of muscle is 7.89%, 15.75% and 28.79%.

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MODERNISM AND QUALITY IN VOLLEYBALL GAME THE II-LINE ATTACK

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Abstract
Starting from the current analysis on performances in worldwide volleyball and from our internal realities, I considered appropriate to conceptual approach the Romanian volleyball performance optimization strategy, by comparing the results of II-line attack registration, between two romanian teams and one from the italian championship and also their report on the final result of the official volleyball game effectiveness. All this investigation, aims the continuous progress of the volleyball game, and implicitly the internal performance strategies allignment to the trends and guidelines of the modern game, which is always based on surprising the opponent.
Key words: *volleyball, II-line attack, efficency.*

INTRODUCTION

Worldwide voleyball evolution knows a special dynamic, both in terms of developing the content and the impressivness of the game, and also regarding the popularity and spreading area, natural consequence of the policy, which FIVB practice consistently in this direction. (Cojocaru A., 2007, 9).

The continuous progress of the volleyball game, can not be designed and built without a correlated, integrative approach of all the performance components, starting from the human resources (athletes, technicians), scientific resources (research, methodology, medicine), technical-tactical and organizational (specialized units, competitive systems, management) and up to intimacies of the preparation process, the content of training and game (programming, methods and means, control, supervision, directing, evaluation, technical-tactical actions, game models etc). (Ioniță, M., 2007, pp. 41, quoted in the Cojocaru, A., Cojocaru, M., Țurcanu, F., Țurcanu, D., 2011, pp. 285).

In the context of the performance perspective in a volleyball game, we consider that improvement and contionous modernization are necessary, not through a simple knowledge selection, but through a restructuring of the entire performance system, in relationship with the appereance of the surprise element in the first phase of the game. This surprise element can only be, in our acknowledgment the II-line attack.