121 - SWIMMING TRAINING – AUTOMATIZED RELAYS

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INTRODUCTION

Trainingis usually hard. Few people are or can beprepared tocompete in highlevel. Clearly ifwe Brazilianshave anyintention of eventuallyleavean OlympicsGames with more thanfewmedals(and the most brass) isnecessary to investin basetraining.We mustencouragesportsin schools, public and private, as well as at our universities. Fromquantity, we canextractquality andthen we need, encourage and support the athletes.So, maybe some of them can becomesport champions. Othercountriesare ahead of uswithregard to theseissuesand for these reason, they havesuperior performance inhigh-level competitions.

Going back to the theme, Olympics Games, actually very in evidenceas well as thenext one will beinBrazil, we have to considerthe followingfact: Our performanceis notconsistent withthe current position ofBrazilat the global economy, once thatour countryisholding thesixth largestGD –site:Terra (2013). We are goodin somegroup sportssuch as: soccer and volleyball. However, outsidefew exceptions(great athletes), at individual sportswe are weak–site: Folha de São Paulo(2012). Unfortunatelyfor us, at the Olympics Gamesareindividual sportssuch as athletics, swimming, and various forms ofstruggles the sports that give more medals.

WeBrazilians like group ball sports, as they are naturallyfun and make partof our culture. Moreover, the long tradition ofpositive resultsand the frequent grow-up of great talents at these sports incentive thekidstopractice them. At Brazil this is a way of social ascension. If the childrenbecomea great soccer player, certainly, fame andfortune will comeas a result. However, asdiscussed earlier, we need to encouragethe practice ofindividual sports. As we explain before, is essential to produce good athletes at these sports if we intend improve our results at the Olympics Games. The questionishow to do it? How to encourageour childrento practiceswimming orathletics,for example?How tomake the trainingmore interestingfor our childrenand teenagers?

Well,the relays are often used in swimming training as a funny way of produce dispute between the athletes. Thus, the sport becomes funny for them and athletes do their training with more pleasure and determination, especially if the athletes are children.Usually coaches organize the relays choosing some "team captains" (usually the fastest or the most experienced athletes). Then, the team captains choose the other athletes of their respective team. This method often generates some relays teams much stronger than others, thereby reducing the effectiveness of the training. The problem is, because if there is a great difference in performance between the teams, during the training some of the relays teams can no longer win and the young athletes may do not give the best of themselves at the training. Asin mostcases, arethe best athleteswhoclosethe relays, the situationbecomeseven more critical.

This paper presents a methodology that, by using specific software, automates the selection of relay's team members and makes the relays much more counterparts. Thus, increase the competitiveness between the teams and helps the training to achieve their goals. As the methodology guaranty that all the relays teams will have similar performance, the competitiveness between the teams is improved and, thus, makes the training more interesting for the athletes.

METHODOLOGY

The methodologyshown belowwas developedfor optimized swimming relays.However, nothing prevents that the same methodology, withsome modifications,can be applied toother sports such asathletics.

Let's go back to swimming training. We believe thatform a singleteam thatcan compete wellthe relaysat fourstrokes (backstroke, butterfly, breaststroke and crawl)is more efficientthan modifyingthe teamto competeineach style,aswell, this stimulateteamworkand is givesopportunity tothe same team that go bad in one relay of some strokeperform well in other. Thus, these create the following problem:How to assemblecompetitive teamsat the four strokes at the same time?

Thetraining methodologythat form swimmingrelaysmore competitiveat the four strokescan bedivided into the followingsteps:

1) Collecting Time: at this stepwe get the time of all the athletes who willparticipate in therelay teamsat the four strokes (backstroke, butterfly, breaststroke and crawl). The time must be registered at the same distance that we intend to do the relay training (for instance: 25 or 50 meters). This step can be repeated several times to guaranty that the time registered be close with the athletes' best performance.

2) Timing List:at this stagethe athletes will berankedin order of increasingtimes(from best to worsttime) in the four strokes.

3) Software Feeding: The timing lists are introduced into the software and we also input some others information like: number of teams, number of teams members, who are the team captains, and which is the maximum difference in seconds permitted between teams.

4) Equivalent CrawlRanking: At this step, the software calculates the Equivalent Crawl Ranking converting the four Timing Lists (one per stroke) in just one.

5) Computer Generation of the Relays Teams: Using the inputted data and the Equivalent Crawl Raking, the computer calculates the best combination of athletes that mounting relays with the mostsimilar performance as possible.

6) Organize the Relays Teams: The coach inform the team captains and the other athletes in which team they will compete.

7) Relays' Strategy: Each captain will define, together with the other team members' when each athlete will go to swim.

8) Running the Relays: The swimming teams disputes the relays in each stroke. At this step is very important taking time of every athlete in order to compare their performance with the time registered atthe Timing List.

THE SOFTWARE

A software wrote in C++ language(PAPPAS, 1991 e JAMSA, 1994) was developed,by the authors, specifically to usethe methodology. The algorithm used at that software is quite simple as we can see in the following steps:

1)Express all the times in seconds. Ex: 1:23 (one minute and twenty three seconds) = 83 s (eighty three seconds).

2)Calculate the average time (in seconds) at the four strokes (backstroke, butterfly, breaststroke and crawl). That means to calculate the arithmetic time average of each team:

$$Tm_i = \frac{\sum_{j=1}^{n} T_{ij}}{n} \quad (1)$$

where,

n: number ofathletes per team

j: index that represents one specific athlete.

i: index that represents one specific stroke.

i = 1: backstroke

i = 2: butterfly

i = 3: breaststroke

i = 4: crawl

Tj: the time of one specific athlete.

Tmi: the time average in one specific stroke.

3)Calculate the Crawl Equivalent conversion factor (Fec) to the four strokes:

$$Fec_i = \frac{Tm_4}{Tm_i} \quad (2)$$

Note: Of course that if “i=4” (crawl) then Fec = 1.

4)Then the CrawlEquivalent Time (Tec) of each athlete at each stroke can be calculate as:

$$Tec_{ij} = (T_{ij}) .(Fec_i) \quad (3)$$

5)From the Crawl Equivalent Time (Tec) of each athlete at each stroke is possible to calculate the Equivalent Average Time per athlete:

$$Tec_j = \frac{\sum_{i=1}^{4} Tec_{ij}}{4} \quad (4)$$

Finally,using the inputted data and the Crawl Equivalent Raking, the computer calculates the best combination team members that guaranty that the sum of Crawl Equivalent Times(Tec_j) of each team be very close.In other words, the computer calculates the best combination of athletes that mounting relays with the most similar performance as possible.

PRACTICE TESTAND RESULTS

The practical testof the effectivenessof thetraining methodologywasdone ona swim teamcomprised ofathleteswith ages between 8 and 17 years old at"Tuna LusoBrasileira" club which was thencoached byExpeditoRaposo, co-authorof this work. The grouppresent on the dayof the relaywas comprised by36athletes, divided in: 20 teenagers(12 men8women) and 16children (9 boys and7girls).

About a week before, we have made several collecting times at all the four strokes in 25 and 50meters. We decide to feed the computer with the Timing List made from the 25 meters times. The athletes were divided in four teams with nine members in each relay and the maximum time difference between teams was defined as2 seconds. Then, the four fasted swimmers were selected to be the team captains.

All this information was inputted into the software that, based at the Crawl Equivalent Ranking, choose the best combination of athletes that permit relays with the most similar performance as possible. The Table 1 shows the teams and their Crawl Equivalent Times in seconds.

Table 1–The teams and their Equivalent Crawl Times (s)

Team 1		Team 2		Team 3		Team 4	
nome	T (s)	nome	T (s)	nome	T (s)	nome	T (s)
athlete 1	13,1	**athlete 2**	13,2	**athlete 3**	13,3	**athlete 4**	13,5
athlete 10	27,5	athlete 8	27,4	athlete 7	27,4	athlete 5	27,4
athlete 6	41,4	athlete 9	41,9	athlete 11	42,2	athlete 12	42,4
athlete 17	57,2	athlete 15	57,5	athlete 13	57,3	athlete 14	57,4
athlete 20	73,5	athlete 16	73,2	athlete 19	73,4	athlete 18	73,3
athlete 21	90,5	athlete 24	91,0	athlete 22	90,6	athlete 23	90,8
athlete 28	109,3	athlete 25	108,9	athlete 27	109,4	athlete 26	109,3
athlete 30	129,2	athlete 32	129,8	athlete 29	128,7	athlete 31	129,7
athlete 35	151,5	athlete 33	151,1	athlete 36	151,5	athlete 34	151,8
2°		1°		2°		4°	

Observing Table1we see that thedifferencebetween the slowest time(151.8 s - Team4) and the fastest (151.1 s - Team1) is only 0.7 s, what shows that, all the teams haveabout the samestrength.However,TECs(CrawlTimeEquivalent) shownin Table1, are usefulonlyto assemblethe teams. In addition to thisthe softwareis also able tomake results predictionsfor the team performance at each stroke. Table 2shows the prediction resultsfor eachteam at the four strokes in seconds.

Table 2 – Prediction resultsfor eachteam at the four strokes (s).

	Backstroke		Butterfly		Breaststroke		Crawl	
Classification	Team	Time	Team	Time	Team	Time	Team	Time
1°	Team 2	154,9	Team 4	152,2	Team 1	162,8	Team 2	151,1
2°	Team 3	155,2	Team 3	152,7	Team 4	164,5	Team 3	151,2
3°	Team 1	156,0	Team 2	152,8	Team 2	163,2	Team 1	151,5
4°	Team 4	157,5	Team 1	153,2	Team 3	164,5	Team 4	152,1
Dif 1° / 4°		2,6		1,0		1,7		1,0

The prediction results shown in Table2 are usefulto show thatin fact, the teamspresented similar performance at the four strokes, as themaximum difference betweenthe 1stand 4thplaceoccurredinbackstrokeand itwas only 2.6seconds.Thecoach canalso use these resultsshowed in Table2in order to compare the predictionperformanceversus the real one of each team. However, we believe that is better do not show those predictions to the athletes before the competition in order do not interferes on the results.

Then, the coach informedto the team captains and to the other athletes in which team they will compete. After that, each captain had about 10 minutes to define, together with the other team's members the strategy that will be used.

Finally, the athletes swim the relays in the following stroke's order: Backstroke, Butterfly, Breaststroke and Crawl. The real relay's timeresults in seconds are showed at Table 3.

Table 3 – The real relay's results (s)

	Backstroke		Butterfly		Breaststroke		Crawl	
Classification	Team	Time	Team	Time	Team	Time	Team	Time
1°	Team 1	157,2	Team 3	149,9	Team 1	158,1	Team 3	145,7
2°	Team 2	157,7	Team 2	151,1	Team 2	163,3	Team 1	146,8
3°	Team 4	159,0	Team 4	153,3	Team 3	163,5	Team 2	149,8
4°	Team 3	160,4	Team 1	155,3	Team 4	165,4	Team 4	154,2
Dif 1° / 4°		3,2		5,4		7,3		8,5

An important information that we can take from the real relay's results showed at Table 3 if we compare with predicted results showed at Table 2 are that the predictions were wrong. However, all is fine, because the only prediction that we would like to confirm was that will be almost impossible to predict who will win. In other words, we would like to confirm if the computer really assemble teams with similar performance. What, based on the results, we can say that's true. Anyway, analyzing just the teams' time obtained at Table 3 we can see that they not differ much from the times predicted at Table 2.

CONCLUSION

The results presented on this paper showed that the methodology of assembly swimming relays assisted by computer, by using all the criteria's also commented here, really produce relays teams with similar performance at the four strokes. These makethe results, in terms ofteam's placement,almost unpredictable.Moreover, in mostcasesathletesperformed better thanexpected, what showthe validity ofthe training asan incentive to improvethe swimmers' performance.

Note that, themethodology presented here, although it was specifically preparedfor swimming,can, with some modifications, be usedfor other sports, such asathletics.

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SWIMMING TRAINING: AUTOMATIZED RELAYS

ABSTRACT

The relays are often used in swimming training as a funny way of produce dispute between the athletes. Thus, the sport becomes funny for them and athletes do their training with more pleasure and determination, especially if the athletes are children. Usually coaches organize the relays choosing some "team captains". Then, the team captains choose the other athletes of their respective team. This method often generates some relays teams much stronger than others, thereby reducing the effectiveness of the training. This paper presents a methodology that, by using specific software, automates the selection of relay's team members and assembly relays with similar performance. Thus, increase the competitiveness between the teams and helps the training to achieve their goals. Finally, the practical results of the use this methodology at a real training of a swimming team are presented and discussed.

KEY WORDS: swimming; relays; automatized.

ENTRAÎNEMENTDE NATATION : RELAIS AUTOMATISÉ

RESUME

Les relais sont souvent utilisés dans l' entraînement natation comme une forme amusant de croie competition dentre les athlètes. Ainsi, le sport devient drôle pour eux et les athlètes font leur entraînement avec plus de plaisir et de détermination, surtout si les athlètes sont des enfants. Habituellement, les entraîneurs organisent les relais de choisir quelques «chefs d'équipe». Ensuite, les chefs d'équipe choisissent les autres athlètes de leur équipe respective. Cette méthode génère souvent des équipes de relais beaucoup plus forts que les autres, réduisant ainsi l'efficacité duentraînement. Cet article présente une méthodologie qui, en utilisant un logiciel spécifique, automatise lasélection de le membres de l'équipe de relaiset faire l'assemblage des equipes avec performance similair. Ainsi, accroître la compétitivité entre les équipes et aide à l'entraînementpour atteindre leurs objectifs. Enfin, les résultats pratiques de l'utilisation de cette méthode à un entraînement reél d'une équipe de natacion sont présentés et discutés.

MOTS-CLÉS : natación ; relais ; automatisé.

ENTRENAMIENTO DE LA NATACIÓN: RELEVO AUTOMATIZADO

RESUMEN

Muchas veces son usados relevos en entrenamiento de la natación como una forma divertida de generar competencia entre los atletas. Por lo tanto, el deporte se convierte en diversión para ellos, lo que hace que los atletas entrenan con más placer y determinación, sobre todo si los atletas son niños. Normalmente los entrenadores organizan los relevos haciendo la elección de algunos "capitanes de equipo". A continuación, los capitanes eligen los otros atletas de sus respectivos

equipos. Este método suele generar algunos equipos de relevos mucho más fuertes que otros, lo que reduce la eficacia del entrenamiento. En este trabajo se presenta una metodología que, con el uso de un programa informático específico, automatiza la selección de los miembros del equipo de relevos y hace relevos vuelven mucho más igualados. Así, se sucede un aumento de competitividad entre los equipos lo que ayuda el entrenamiento a alcanzar sus metas. Al Fin, los resultados prácticos de la utilización de esta metodología en un equipo real de natación son presentados y discutidos.

PALABRAS CLAVES: natación; relevo; automatizado.

TREINO DE NATAÇÃO: REVEZAMENTO AUTOMATIZADO

RESUMO

Revezamentos são frequentemente utilizados em treinamentos de natação como uma maneira divertida de gerar disputa entre os atletas. Assim, o esportes e torna divertido para os mesmos, o que faz com que os atletas teinem commais prazer e determinação, especialmente se eles forem crianças. Normalmente treinadores organizamos revezamentos escolhendoalguns "capitães de equipe". Em seguida, os capitães escolhem demais atletas de sua respectiva equipe. Este método gera frequentemente algumas equipes de revezamento muito mais fortes do que outras, reduzindo assim a eficácia do treinamento .Este trabalho apresenta uma metodologia que, através da utilização de software específico, automatiza a seleção dos membros da equipe de revezamento e faz com que os revezamentos se tornem muito mais equiparados. Assim ,aumenta a competitividade entre as equipes e ajuda ao treinamento a alcançar seus objetivos .Finalmente, os resultados práticos da utilização dessa metodologia em um treinamento de uma equipe de natação real são apresentados e discutidos.

PALAVRAS CHAVES: natação; revezamento; automatizado.