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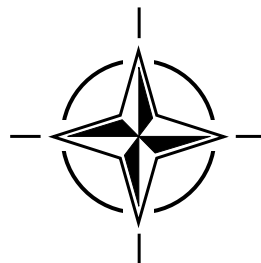
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RTO MEETING PROCEEDINGS 76

Blowing Hot and Cold: Protecting Against Climatic Extremes

(Souffler le chaud et le froid: comment se protéger contre les conditions climatiques extrêmes)

Papers presented at the RTO Human Factors and Medicine Panel (HFM) Symposium held in Dresden, Germany, 8-10 October 2001.



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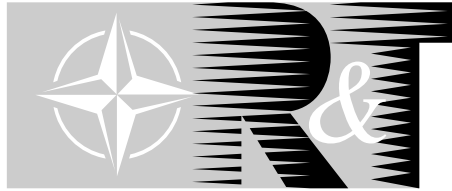
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The Research and Technology Organisation (RTO) of NATO

RTO is the single focus in NATO for Defence Research and Technology activities. Its mission is to conduct and promote cooperative research and information exchange. The objective is to support the development and effective use of national defence research and technology and to meet the military needs of the Alliance, to maintain a technological lead, and to provide advice to NATO and national decision makers. The RTO performs its mission with the support of an extensive network of national experts. It also ensures effective coordination with other NATO bodies involved in R&T activities.

RTO reports both to the Military Committee of NATO and to the Conference of National Armament Directors. It comprises a Research and Technology Board (RTB) as the highest level of national representation and the Research and Technology Agency (RTA), a dedicated staff with its headquarters in Neuilly, near Paris, France. In order to facilitate contacts with the military users and other NATO activities, a small part of the RTA staff is located in NATO Headquarters in Brussels. The Brussels staff also coordinates RTO's cooperation with nations in Middle and Eastern Europe, to which RTO attaches particular importance especially as working together in the field of research is one of the more promising areas of initial cooperation.

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- AVT Applied Vehicle Technology Panel
- HFM Human Factors and Medicine Panel
- IST Information Systems Technology Panel
- NMSG NATO Modelling and Simulation Group
- SAS Studies, Analysis and Simulation Panel
- SCI Systems Concepts and Integration Panel
- SET Sensors and Electronics Technology Panel

These bodies are made up of national representatives as well as generally recognised 'world class' scientists. They also provide a communication link to military users and other NATO bodies. RTO's scientific and technological work is carried out by Technical Teams, created for specific activities and with a specific duration. Such Technical Teams can organise workshops, symposia, field trials, lecture series and training courses. An important function of these Technical Teams is to ensure the continuity of the expert networks.

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Blowing Hot and Cold: Protecting Against Climatic Extremes

(RTO MP-076 / HFM-061)

Executive Summary

On 8-10 October 2001, NATO and Partner for Peace nationals met in Dresden, Germany, to discuss the interaction between the climate, the clothing and equipment, and the physiology of the soldier in relation to its impact on the soldier's, health and operational performance. 118 people participated in the meeting, originating from 20 countries, attending a total of 43 papers. Session topics were: 'Advances in clothing technology', 'advanced technology for heat stress mitigation', 'military benefits of physiological adaptation to heat and cold', and 'modelling, monitoring and thermal limits'.

An underlying theme of the conference was the implication the research presented has for the fight against terrorism. The optimisation of the protection of emergency services (police, fire-fighters, etc.) against fire, chemical and biological hazards was clearly identified as an important spin-off of military research as presented at the meeting. For the military aspects of this theme, many links to the operational requirements for special task units (reconnaissance, etc.) of the research were identified. Other observed themes were:

- The sharply increased use of manikins in clothing and threat (steam, fire) evaluation. Sweating manikins or body parts (hands, feet, head) were presented as recent developments.
- Successful development of personal cooling systems and the development of good evaluation methods.
- Use of spacer materials in heat protection, and for creating spacers for active cooling.
- Continued development of NBC protective clothing towards minimal heat stress, towards integrated (in combat suit) systems and towards materials with increased air permeability for the over-suit systems.
- The optimisation of heat and cold adaptation of soldiers before going on missions to respective areas.
- The successful use of models for prediction of heat and cold stress, survival time, frostbite risk, water requirements, clothing thermal performance, and for hypothesis testing.
- The development of new indices; for classification of physiological strain (heat and cold) and climate.

In the discussions a number of topics with interest from many countries were identified that may be considered in terms of future joint projects or meeting themes:

- Thermoregulatory fatigue.
- Inter laboratory comparison project on performance of dry and sweating thermal manikins.
- Creation of a (black-box) electronic climate analyser, using sophisticated heat balance analyses or even physiological models to transform the climatic measurements of the device into a simple heat stress index for use in the field.

This symposium covered a very wide area of research. Hence, the 43 papers presented here could only be a very selective representation of the whole research field. Though, especially with the excellent review papers, a good overview of the field was presented, the reader should keep in mind that for most topics only a single or perhaps two representative communications were present. This in some cases implied that for areas where controversy is present, only one view was presented at the meeting. This evaluation report attempts to put these papers in perspective, but the reader should bear this problem in mind when going through the original material.

Notwithstanding these remarks, the symposium provided an excellent overview of recent research and developments in this area and as was clear from the many discussions in and outside the meeting room it provided substantial food for thought and ideas for future work.

Given the speed of development in this area, a follow up symposium on the same topic would be valuable in three to five years. Special topic meetings as suggested above, would be relevant before that date.

Souffler le chaud et le froid: comment se protéger contre les conditions climatiques extrêmes

(RTO MP-076 / HFM-061)

Synthèse

Des spécialistes des pays membres de l'OTAN et du Partenariat pour la paix se sont réunis à Dresden, en Allemagne, du 8 au 10 octobre 2001, pour discuter des interactions entre le climat, les vêtements et les équipements, ainsi que de l'impact de la physiologie du combattant sur son état de santé et ses performances opérationnelles. En tout, 118 personnes originaires de 20 pays différents ont participé à la réunion, et 43 communications ont été présentées. Le programme des différentes sessions s'établit comme suit : "Les avancées dans les technologies vestimentaires," ; "les dernières technologies pour diminuer le stress thermique" ; "les avantages militaires d'une adaptation physiologique au chaud et au froid" ; et "la modélisation, le contrôle et les limites thermiques".

L'un des thèmes sous-jacents de la conférence a été l'intérêt marqué des intervenants pour la recherche en matière de lutte contre le terrorisme. L'optimisation de la protection des services d'urgence (police, pompiers, etc.) contre l'incendie avec prise en compte des risques chimiques et biologiques a été clairement identifiée, au cours de la réunion, comme une retombée importante de la recherche militaire. En ce qui concerne les aspects militaires, de nombreux liens avec les besoins opérationnels des forces spéciales (reconnaissance etc.) ont pu être identifiés. Les autres thèmes suivants ont été étudiés :

- L'utilisation fortement accrue de mannequins pour l'évaluation des vêtements et de la menace (vapeur, incendie). Des versions récentes de mannequins et de parties du corps factices (mains, pieds, tête) à exsudation ont été présentés.
- Le développement réussi de systèmes de refroidissement individuels et le développement de méthodes correctes d'évaluation.
- L'utilisation de matériaux séparateurs pour la protection thermique et pour la création de séparateurs pour le refroidissement actif.
- Le développement continu de vêtements de protection NBC, conçus pour limiter le stress thermique, l'intégration (dans les tenues de combat) de différents systèmes, mais aussi de matériaux plus perméables à l'air pour les systèmes portés par dessus les tenues de combat.
- L'optimisation avant le départ en mission dans certaines zones géographiques, de l'adaptation des combattants aux extrêmes climatiques.
- L'utilisation, avec succès, de modèles pour la prévision du stress thermique, des temps de survie, des risques de gelure, des besoins en eau, des performances thermiques des vêtements, et pour la vérification d'hypothèses.
- Le développement de nouveaux indices pour la classification du stress physiologique (chaud et froid) et du climat.

Lors des discussions, un certain nombre de sujets d'intérêt pour de nombreux pays ont été identifiés, lesquels pourraient faire l'objet de futurs projets ou thèmes de réunion conjoints, à savoir :

- La fatigue isothermique.
- Un projet entre laboratoires pour comparer les performances des mannequins secs et ceux à exsudation.
- La création d'un analyseur électronique de climat (du type boîte noire), mettant en œuvre des analyses sophistiquées de bilans thermiques, voire même des modèles physiologiques pour transformer les mesures climatiques de l'appareil en un indice de stress thermique pour utilisation sur le terrain.

Ce symposium a couvert un vaste domaine. Par conséquent, les 43 communications présentées ici ne sont qu'une représentation très sélective du domaine étudié. Néanmoins, et grâce surtout à l'excellente qualité des communications de synthèse, un très bon tour d'horizon a pu être réalisé. Le lecteur doit tenir compte du fait que seule une ou deux communications a pu être présentée pour chaque sujet et pour certains cas litigieux, un seul point de vue a pu être exprimé. Ce rapport d'évaluation tente néanmoins de placer ces communications dans leur contexte, et le lecteur doit en tenir compte en lisant l'ensemble des textes.

En dépit de ces remarques, le symposium a donné un excellent aperçu des travaux de recherche et des développements récents dans ce domaine, et beaucoup d'éléments de réflexion et d'idées pour les travaux futurs sont ressortis clairement à travers les nombreuses discussions qui ont eu lieu pendant et après la réunion.

Etant donné la rapidité des développements dans ce domaine, il est apparu opportun d'organiser un autre symposium sur ce même thème dans trois à cinq ans. Comme il est recommandé ci-dessus, il serait souhaitable également d'organiser des réunions de spécialistes sur ces sujets avant cette date.

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14. Abstract			
<p>Exposure to heat and cold, as well as the thermal stress induced by protective clothing strongly influences operational effectivity of the soldier. On 8-10 October 2001, NATO and Partner for Peace nationals met in Dresden, Germany, to discuss the interaction between the climate, the clothing and equipment, and the physiology of the soldier in relation to its impact on the soldier's health and operational performance. 118 people participated in the meeting, originating from 20 countries, attending a total of 43 papers. Session topics were: 'Advances in clothing technology', 'advanced technology for heat stress mitigation', 'military benefits of physiological adaptation to heat and cold', and 'modelling, monitoring and thermal limits'. Apart from the military aspects, also the spin-off of the research for civilians and emergency services was discussed and this was seen as an important application of the research findings. Other observed themes were: -The sharply increased use of manikins in clothing and threat (steam, fire) evaluation; -The successful development of personal cooling systems and the development of good evaluation methods; -The use of spacer materials in heat protection, as well as for creating spacers in clothing through which air for active cooling can be provided; -The continued development of NBC protective clothing towards minimal heat stress; -The optimisation of heat and cold adaptation of soldiers before going on missions to respective areas; -The increase in successful use of models for prediction of heat and cold stress, survival time (hypothermia), frost bite risk, water requirements, clothing thermal performance, and for hypothesis testing in terms of the thermoregulatory system; -The development of new indices; for classification of physiological strain (heat and cold) and for the climate.</p> <p>In the discussions topics for future joint projects or meeting were defined: -Thermoregulatory fatigue; -An inter-laboratory comparison of performance of dry and sweating thermal manikins; -The creation of a (black-box) electronic climate analyser which would use sophisticated heat balance analyses or even physiological models to transform the climatic measurements of the device into a simple heat stress index for use in the field which eventually could replace WBGT instead of mimic it.</p> <p>The symposium provided an excellent overview of recent research and developments in the area and provided substantial food for thought and ideas for future work.</p> <p>Given the speed of development in this area, a follow up symposium on the same topic would be valuable in three to five years. Special topic meetings as suggested above, would be relevant before that date.</p>			

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