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RESEARCH AND TECHNOLOGY ORGANISATION

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RTO EDUCATIONAL NOTES **EN-SCI-142**

Robust Integrated Control System Design Methods for 21st Century Military Applications

(Méthodes de conception de systèmes de commande robustes intégrés pour applications militaires au 21ème siècle)

The material in this publication was assembled to support a Lecture Series under the sponsorship of the Systems Concepts and Integration Panel (SCI) presented on 12-13 May 2003 in Forlì, Italy; 15-16 May 2003 in Setúbal, Portugal; and 29-30 May 2003 in Los Angeles, USA.

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RTO is the single focus in NATO for Defence Research and Technology activities. Its mission is to conduct and promote co-operative 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 co-ordination 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 co-ordinates RTO's co-operation 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 co-operation.

The total spectrum of R&T activities is covered by the following 7 bodies:

- 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.

RTO builds upon earlier co-operation in defence research and technology as set-up under the Advisory Group for Aerospace Research and Development (AGARD) and the Defence Research Group (DRG). AGARD and the DRG share common roots in that they were both established at the initiative of Dr Theodore von Kármán, a leading aerospace scientist, who early on recognised the importance of scientific support for the Allied Armed Forces. RTO is capitalising on these common roots in order to provide the Alliance and the NATO nations with a strong scientific and technological basis that will guarantee a solid base for the future.

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Robust Integrated Control System Design Methods for 21st Century Military Applications

(RTO-EN-SCI-142)

Executive Summary

During recent years, guidance and control system design engineers have indicated a growing need to "Bridge the Gap" between theory and the real world considerations, in developing viable cost-effective control system designs for a broad range of anticipated future military applications. This desire to "Bridge the Gap" is further enhanced by the complexity of the 21st century control systems which will, in general, involve highly innovative configurations and system technologies that will have an impact on increasing the cost and the time involved in achieving a successful design. These two factors are of concern to NATO leaders who are concerned with the rising cost of their respective military budgets. Thus, the lecturers will provide insight to the control engineer that may lead to bridging the gap between theory and applications. This insight, for example, is useful in analyzing innovative control systems in the presence of parametric uncertainty. The impact of the topics that are presented on the cost and time involved in designing a modern 21st century control system is also addressed.

Méthodes de conception de systèmes de commande robustes intégrés pour applications militaires au 21ème siècle

(RTO-EN-SCI-142)

Synthèse

Au cours des dernières années, les concepteurs de systèmes de guidage et de pilotage ont signalé à plusieurs reprises qu'il était urgent, dans le développement de concepts de systèmes de pilotage viables et rentables pour un large éventail d'applications militaires futures, de « combler le fossé » entre la théorie d'une part, et les considérations d'ordre pratique d'autre part. Ce souhait de « combler le fossé » est encore amplifié par la complexité des systèmes de contrôle du vingt et unième siècle, qui impliquera, en général, la mise en œuvre de configurations et de technologies de systèmes hautement novatrices ce qui aura pour conséquence une augmentation des coûts et des délais de réalisation de ce type de matériel. Ces deux facteurs sont préoccupants pour les hauts responsables de l'OTAN, inquiets de la hausse des coûts dans leurs budgets militaires respectifs. Les conférenciers fourniront donc aux concepteurs travaillant dans ce domaine des aperçus susceptibles de combler les lacunes existant entre la théorie et les applications. De tels aperçus peuvent s'avérer utiles, par exemple pour l'analyse de systèmes de pilotage en présence d'incertitudes paramétriques. L'impact des sujets présentés sur les coûts et les délais de conception de systèmes de pilotage modernes au 21ème siècle est également examiné.

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The complexity of the 21st century control systems will, in general, involve highly innovative configurations and system technologies that will have an impact on increasing the cost and the time involved in achieving a successful design. These two factors are of concern not only to NATO leaders but to industry who are concerned with the rising cost of their respective military and commercial budgets. Thus, the lecturers will provide insight to the control engineer that may lead to bridging the gap between theory and applications. This insight, for example, is useful in analyzing innovative control systems in the presence of parametric uncertainty. The impact of the topics that are presented on the cost and time involved in designing a modern 21st century control system is also addressed. This lecture series stressed mainly the theory whereas Lecture Series SCI-166 which is Part II, which is to be given in May 2005, will stress applications of this theory.

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