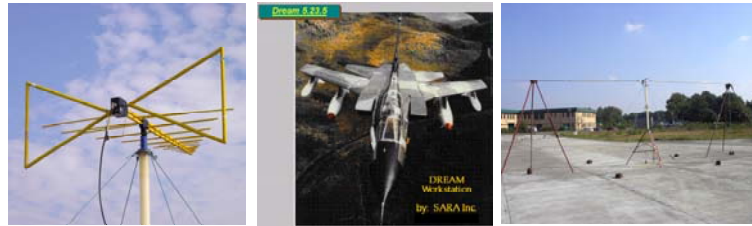


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Low Level Swept Techniques and Convolution with Time Domain Environments

Anthony Wright, Richard Hoad, Dr Ivor Morrow (Cranfield University)
A presentation to EUROEM 2004
13.06.2004

This work was supported by the UK MoD Corporate Research Programme (CRP)

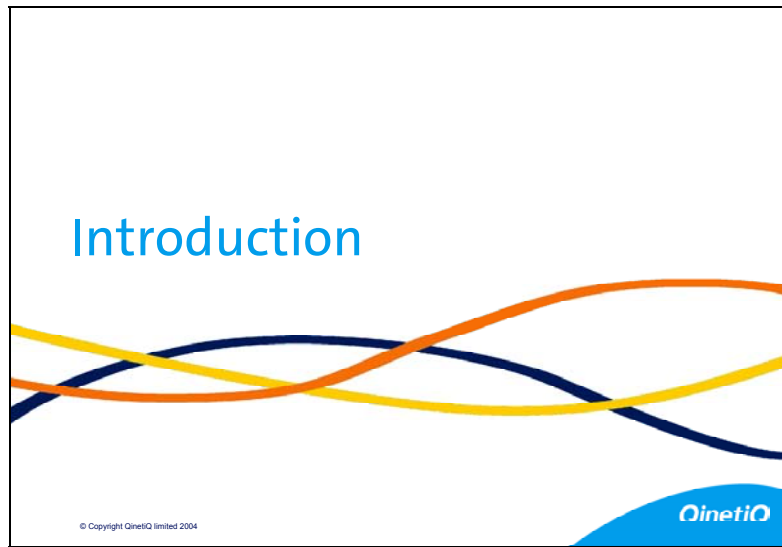
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- 2 HIRF Assessment
 - Low Level Swept Current
 - Frequency Domain Environments
 - Time Domain Environments
- 4 Conclusions

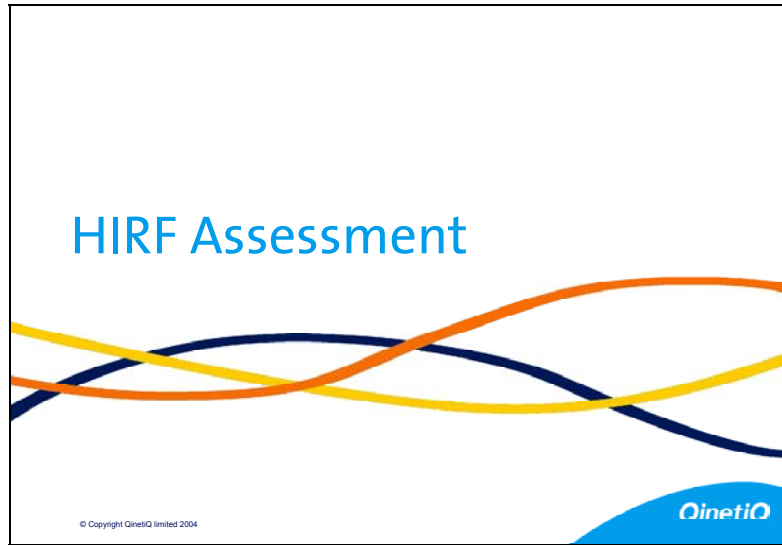
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Introduction

- Low level techniques
 - Low Level Swept Current (LLSC)
 - Cable coupling regime
 - Transfer function of cable loom
 - Low Level Swept Field (LLSF)
 - Aperture coupling regime
 - Attenuation profile of bay

Slide 6



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Background

- Low level techniques developed in late 1970's
 - Mitigate use of High level testing
 - Fly-by-wire Jaguar early 1980's
- Used by aviation community for clearance of aircraft
 - High Intensity Radiated Fields (HIRF)

Low Level Swept Current (LLSC)

- Transfer function of cable loom of interest
- Two parts to assessment
 - Measurement of the reference field
 - Measurement of induced bulk current
- Three frequency bands
 - Cable coupling regime
 - HF - 500kHz to 25.5MHz (Dipole)
 - VHF - 25MHz to 205MHz (Bi-log)
 - UHF - 200MHz to 400MHz (Bi-log)

Reference Field

- Distance from centre of Equipment Under Test (EUT)
 - At least 1.5 times maximum dimension of EUT
 - Greater than 20m
 - Field uniformity
- Fixed transmit height
- Receive height determined by centre line of EUT
- Swept Field

Slide 10



Bi-log



Dipole



ACD-0



ACD-10

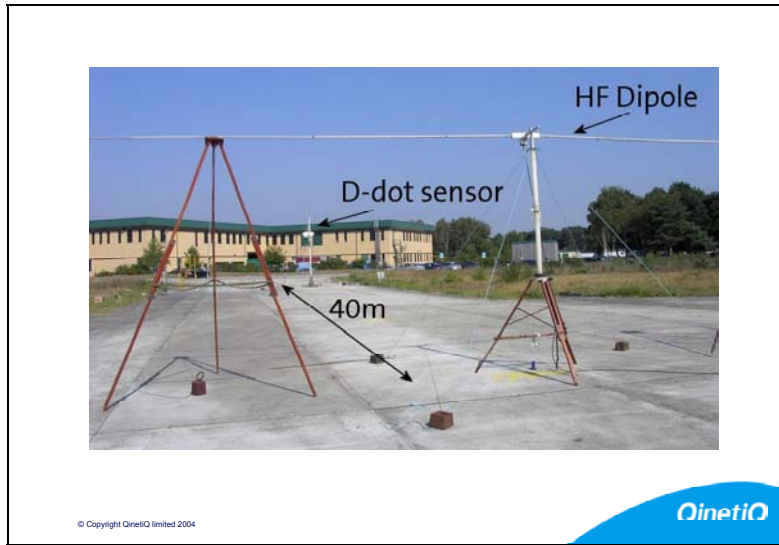


ACD-4

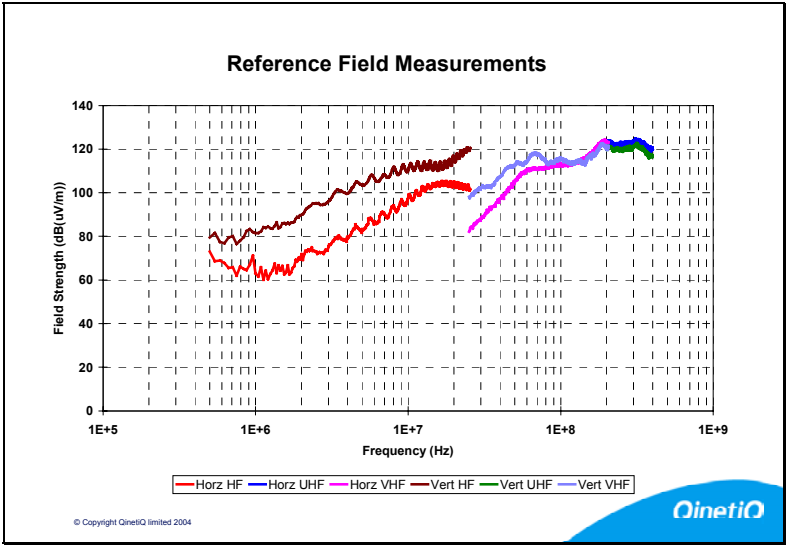
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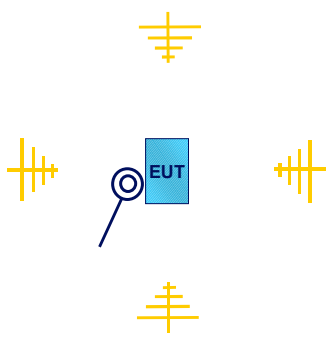
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LLSC Set-up



- Polarisation
 - Horizontal
 - Vertical
- Orientation
 - Nose
 - Tail
 - Left
 - Right
- Data frequency tied

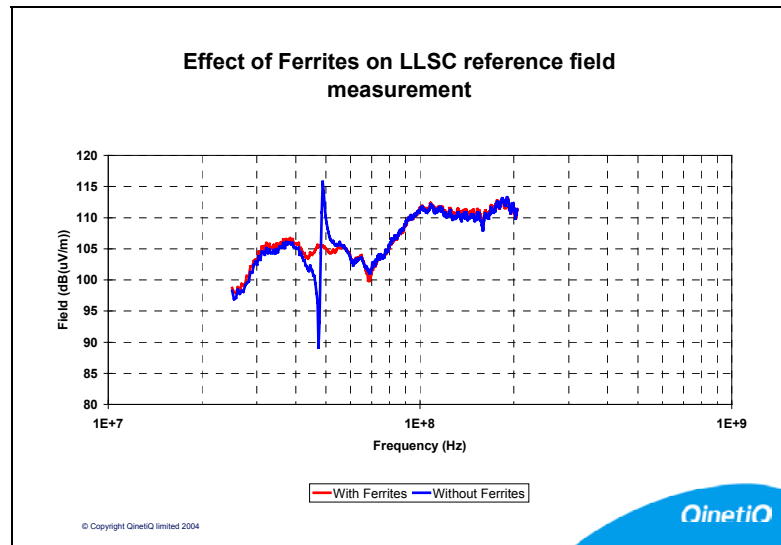
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Induced Currents

- Recorded whilst the measured reference field is incident
- Cable looms are 'probed-up'
 - Ferrite loaded





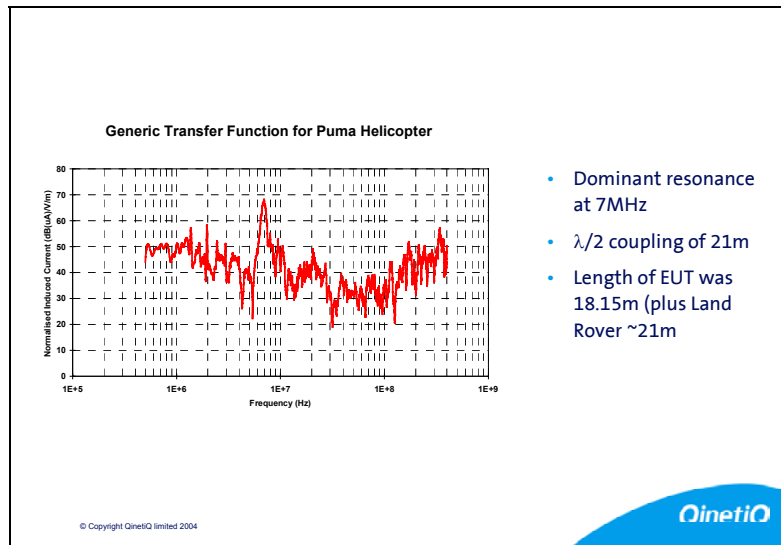
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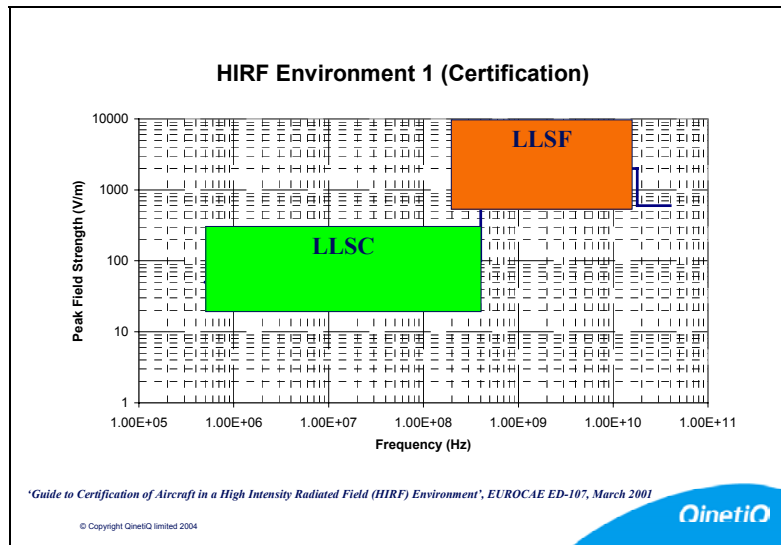
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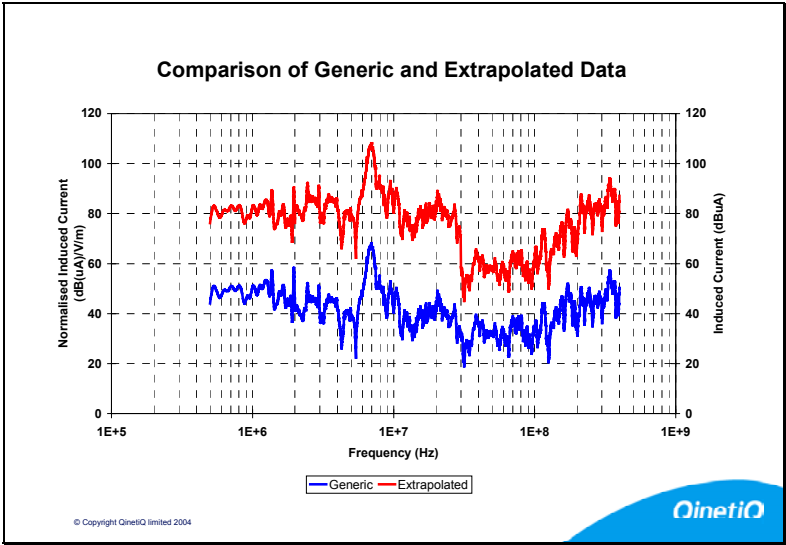


Frequency Domain Environments

- HIRF assessment requires suitable environment
- Specified in
 - EUROCAE ED-107
 - AE4 E3 Committee ARP-5583
 - NATO AEWG 7116AE

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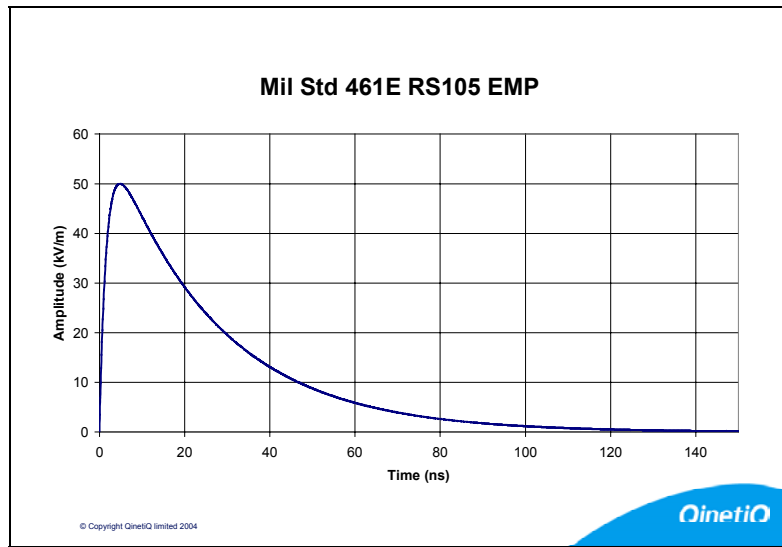
Bulk Current Injection (BCI)

- Extrapolation is the limit line for susceptibility assessment
 - BCI

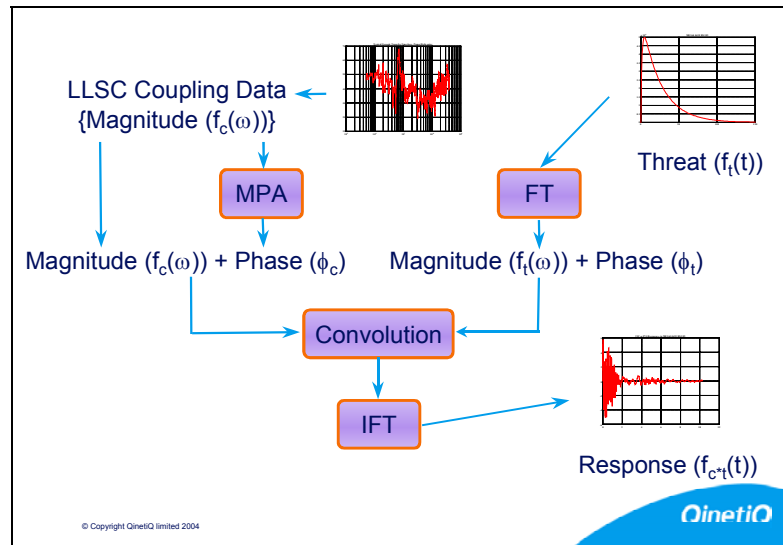
Time Domain Environments

- Require different approach than Frequency Domain
- Typical environments include:
 - Lightning (LEMP)
 - Nuclear Electromagnetic Pulse (NEMP)
 - In-band to LLSC data

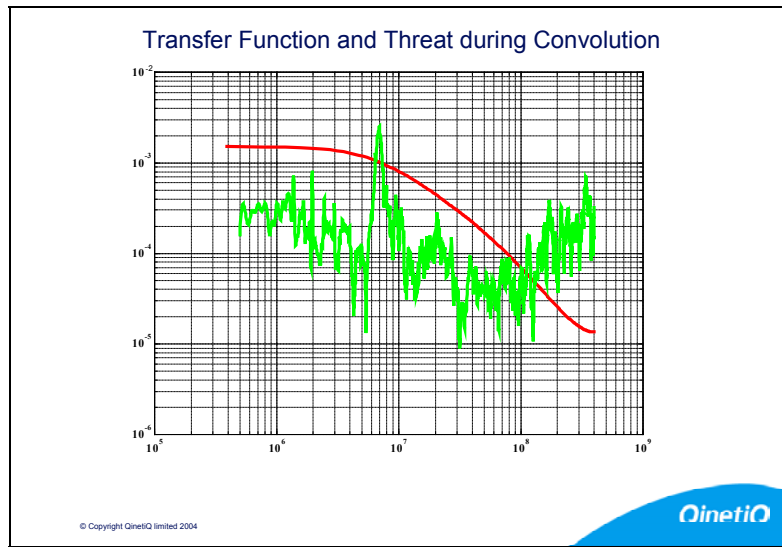
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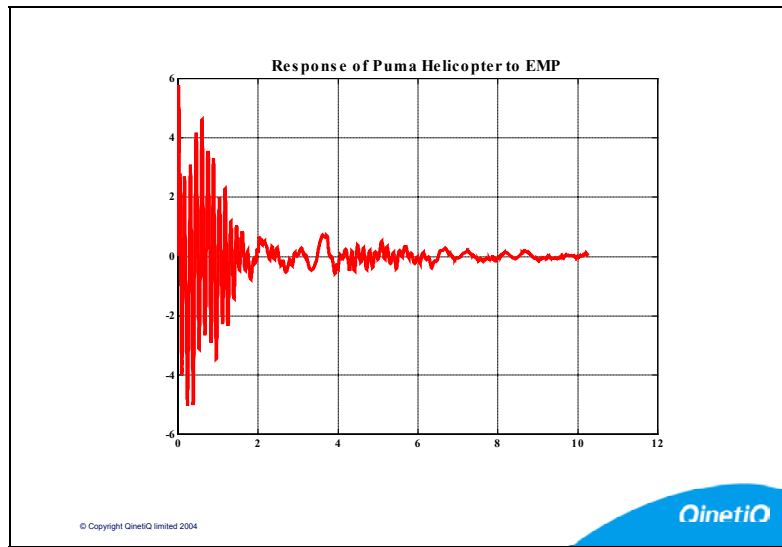
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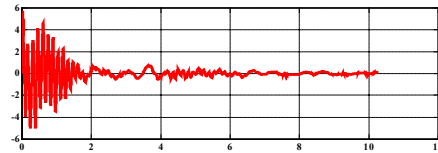


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Damped Sinusoid Injection (DSI)

- Dominant resonance at 7MHz
- Max current 5.8A
- Susceptibility assessment achieved with DSI at frequencies with content >20% max. current

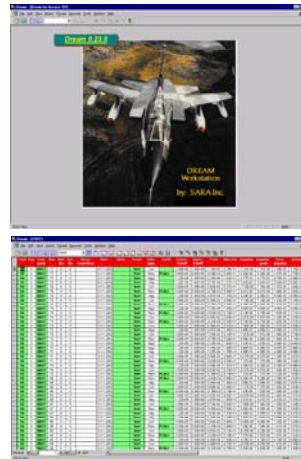


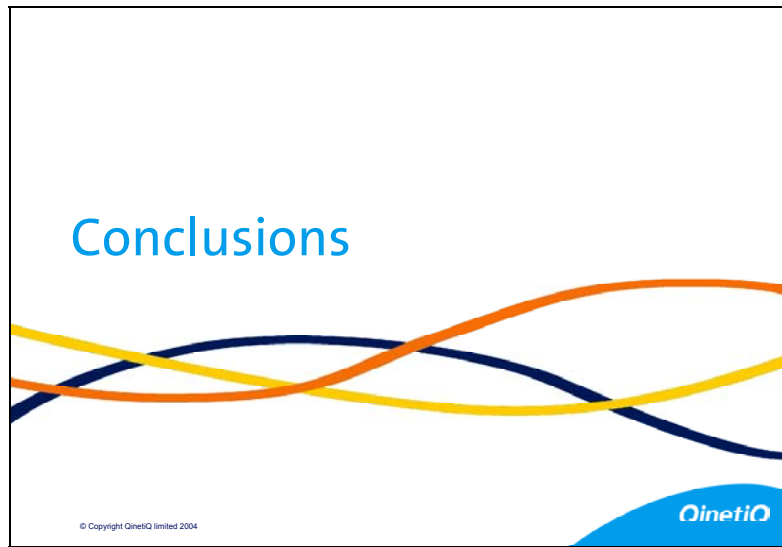
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DREAM

- Developed by Sara Inc. for QinetiQ
- Used for collecting a variety of trials data
 - LLSC, LLSF, Susceptibility, Transients etc
- LLSC
 - Ties frequency data
 - Creates Generic profile
 - Extrapolates
 - Convolves





Conclusions

- LLSC technique
 - Transfer functions
 - Extrapolation to frequency environment
 - Profile for BCI
- HIRF techniques applied to Time Domain Environment
 - Mil Std 461E RS105 EMP
 - Predicted transient response of cable loom
 - Profile for DSI

Conclusions

- Advantages
 - Useful for large distributed systems
 - In situ
 - Not feasible for a high level test
 - Transfer function allows convolution with all in-band environments
- Disadvantages
 - Modern aircraft
 - Little room for current probes
 - Synergistic effects
 - Can be considered with multiple DSI points

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DSpace

<https://dspace.org/>

Low level coupling techniques for the HIRF clearance of air systems

Wraight, Anthony; Hoad, Richard; Morrow, Ivor L.

2004-09-06

IEEE

<https://doi.org/10.23919/emc.2004.10805863>

Wraight A, Hoad R, Morrow IL. (2004) Low level coupling techniques for the HIRF clearance of air systems. EMC Europe 2004, International Symposium on Electromagnetic Compatibility. 6-10 September 2004, Eindhoven, The Netherlands