

# Fogging and Respiratory Simulation System (FARSS)

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# Overview

- Purpose and description
- History and development
- Vision measurement
- Hardware upgrade
- In use

# Purpose of the FARSS

The main aims of the FARSS equipment are:

1. Measurement of vision loss due to respirator lens fogging under a range of environmental conditions and work rates.
2. Measurement of respirator valve performance, specifically valve icing.
3. Environmental test chamber for system and component testing

# What is the FARSS?

- Head form
  - Heated
  - Multiple controllable sweat points
  - Controllable humidified breath (heated)
  - Vision system
  - Multiple optional sensors (minicam, pressure, humidity)
- Chamber
  - Programmable temperature (-50°C to +55°C) and relative humidity (5% to 98%)
  - Visual target for vision system
- Controlling computer
  - Variable parameters
  - Vision capture



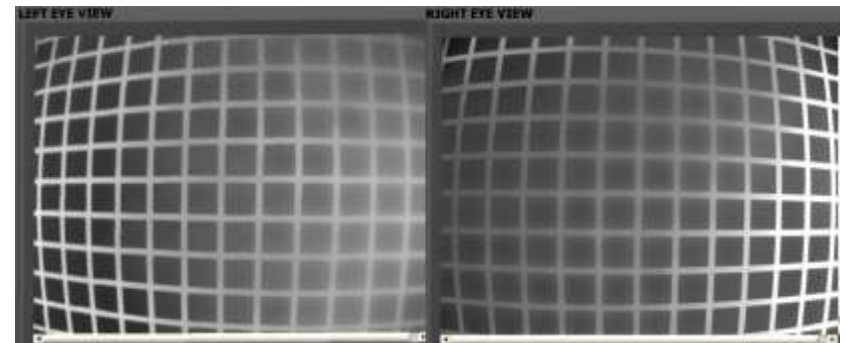
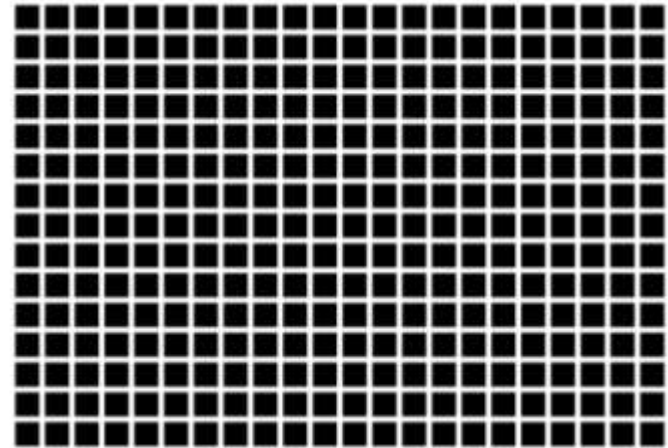
# History and Development

- Originally developed for the APED (Aircrew Protective Equipment and Detection) programme, with Crawley Creatures (i-bodi)
- Unique facility
- Working prototype continually developed and improved
  - Change from absorbent, fibrous sweat pads to porous pads
  - Change from 2 piece skin to single
  - Change from coloured to clear skin



# Original Vision Measurement Method

- Visual acuity
- Measured at high contrast only
  - Maintained quite well in the presence of light scatter produced by fogging
- Unable to reliably determine functional vision loss by fogging
- Increased sensitivity to fogging at periphery due to camera lens distortion
- Fine for APED MOC – binary yes/no answer required
- Required improvement

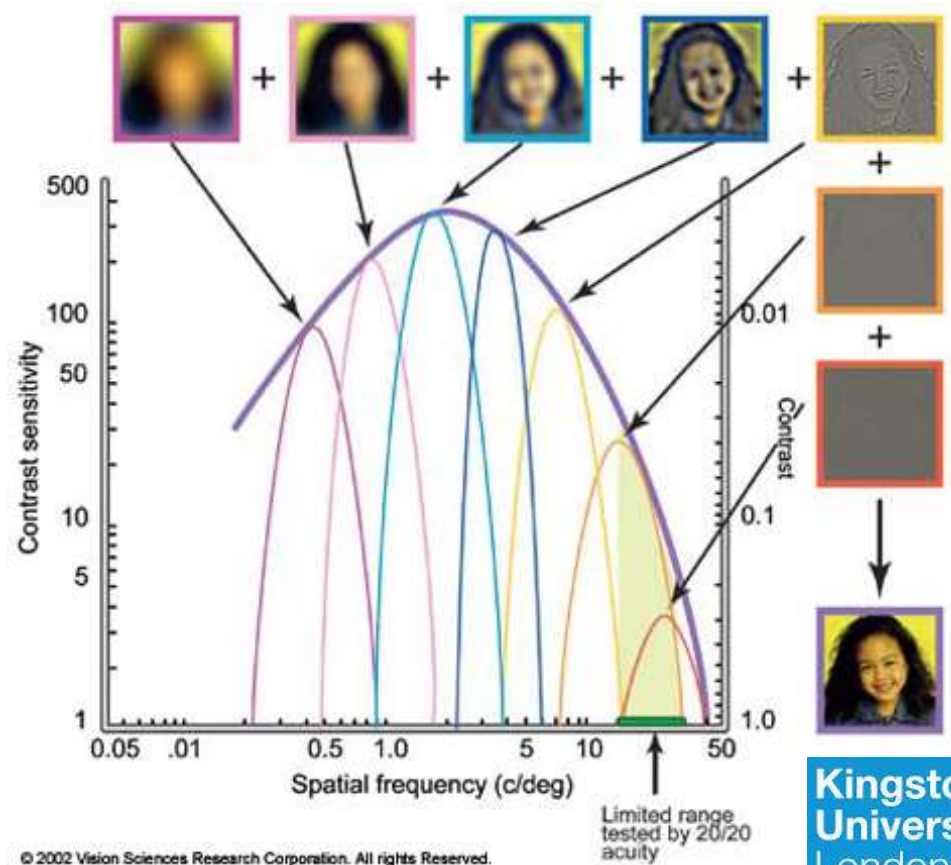


# Change of Vision Measurement Method

- Funding acquired to upgrade FARSS hardware and software, including the vision measurement system
- Allow a meaningful assessment of the types of task affected by fogging, taking into account location and severity of fogging on eyewear
- ITT to industry and academia to provide SME advice and analysis algorithm(s)
- Kingston University London successful bidder

# Contrast Sensitivity Function (CSF)

- Wide range of contrast and frequencies in real world scenarios
- Different responses dependent on frequency and contrast
- New software algorithms to detect change in shape of CSF caused by fogging
- Relate vision loss to functional vision (types of tasks affected)



Kingston  
University  
London



# Contrast Sensitivity

- Pelli-Robson chart normally used to assess contrast sensitivity
  - West *et al.*, “How Does Visual Impairment Affect Performance on Tasks of Everyday Life?”, *Arch. Ophthalmol.* (2002), 120:774-780
- Chart used to determine fogging thresholds
- Contrast attenuation values along with location of fogging used to determine the tasks affected
- Software assumptions
  - Static image (notional human observer’s gaze is directed at the centre of the image)
  - Software does not account for optical distortion produced by a change of focus of the eye for varying distances
  - Fogging thresholds calculated on the basis of a notional human observer with good/exceptional contrast sensitivity



# Vision Measurement Software

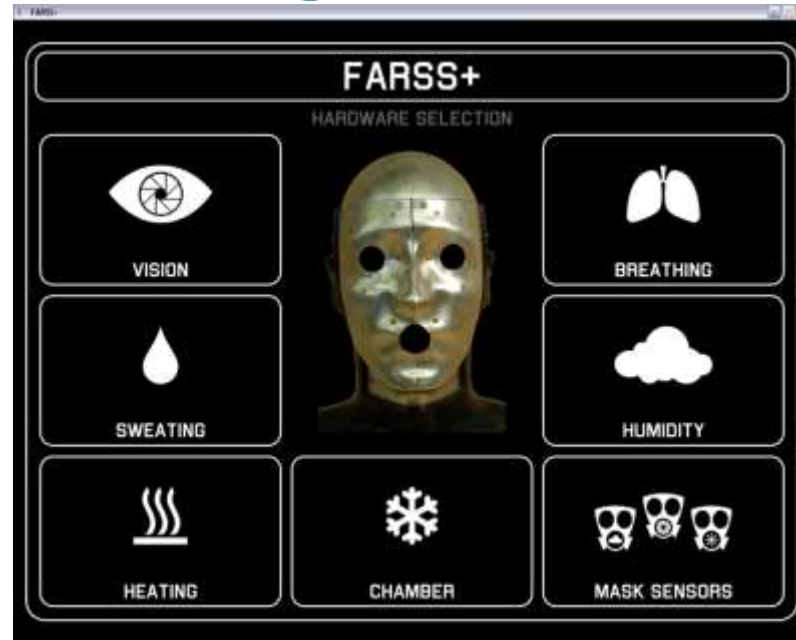
- User determines tasks of interest
- User enters values of contrast threshold values from lookup table into software (example in table)

Degree of fogging	Activity	Vision region affected	Band-limited log contrast
Light	Reading	Foveal	-2.45
Medium	e.g. inserting a key	Foveal	-2.85
Severe	Walking over terrain	Foveal / peripheral	-3.25

- Foveal tasks – use worst fogged square in foveal region
- For mobility tasks – use overall average of all squares (foveal and peripheral)
- Post-processing allows multiple thresholds to be examined

# FARSS Hardware Upgrade

- Significant upgrades
  - Breathing machine
  - Sweat delivery system
  - Breath humidity system
  - Improved reporting
- Additional items
  - Mini camera
  - Pressure sensor
  - Humidity and temperature sensor
- Complete re-write of the software
- New target screen containing a range of contrast and spatial frequencies (woodland)



# Work carried out using FARSS

- Significant amount of work for APED [fogging, valve icing, environmental stability]
- Assessment of anti-fog treatments [fogging]
- Reachback questions from theatre [fogging]
- Valve icing questions from ‘specialist user community’
- Environmental testing of items (electrical and non-electrical) for use in theatre