

# Human Behaviour Capture System

## Cognitometrics: the measurement of cognitive interaction

JAZZ - novo ©

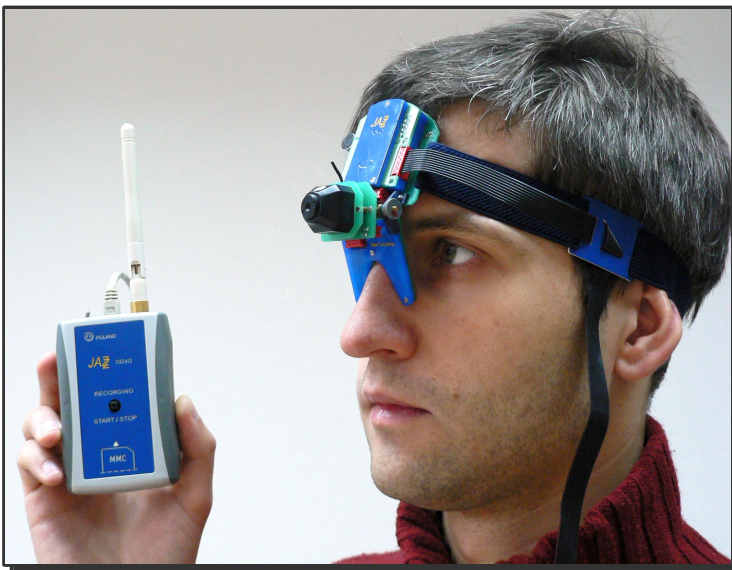


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Operator Attention Monitoring & Warning in low risk high impact situations.  
Operator Selection and On-line Analysis of the training process.



Simultaneous monitoring of:

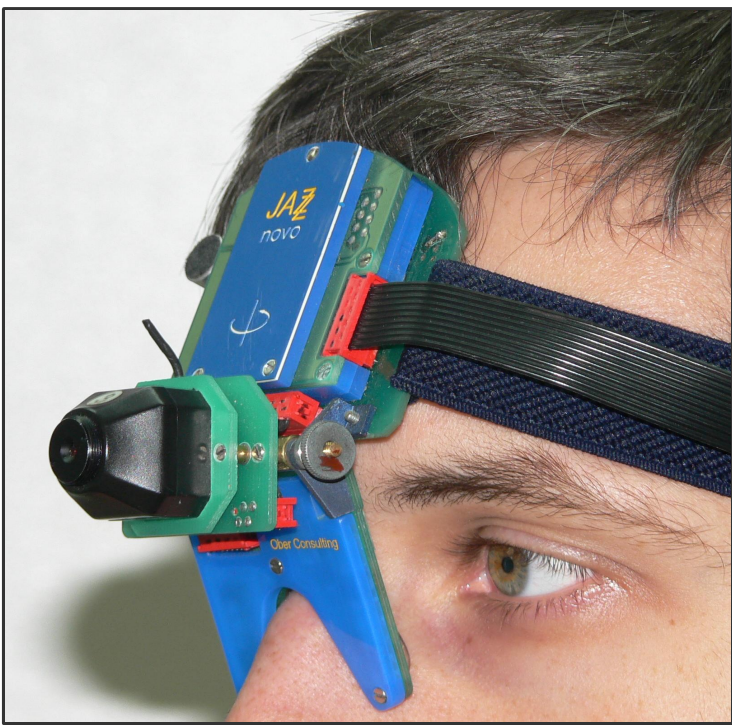
- **ocular motility** (horizontal and vertical)
- **head rotation** (horizontal and vertical)
- **head tilt** (frontal and sagittal plane)
- **heart rate**
- **relative changes in blood oxygenation**
- **operator's speech/background**

Features:

- minimal intrusiveness
- zero setting time
- self calibration
- subject can wear own spectacles
- optical isolation, battery powered
- modular structure
- lightweight (100g)

Options:

- inertial sensing of head rotation
- autonomous data recording on flash memory card
- wireless data transmission
- head-mounted scene camera
- time synchronous monitoring of two operators



The key functions of the Jazz-novo Multisensor system are aimed at monitoring visual attention processes, reflecting the management of the operator's conscious attention. From the point of view of the overall operator's performance, it allows detection of anomalies in attention management. An example is the visual inattention caused by being in the exclusive planning mode: it results in blocking of the information exchange between the supervised environment and the operator's conscious brain (the day-dreaming eyes condition). Instead of being in the control room or in the airliner cockpit, the operator's mind is somewhere else: no-one is taking care of the course of events.

The Jazz-novo system includes a series of improvements over its predecessor, Jazz, among them improved signal quality, increased functional modularity and configuration flexibility. The configuration of the Jazz-novo eye position sensor has been optimised for the better separation of the horizontal and vertical eye movements. A new mounting post has been added to the sensor assembly, allowing it to accommodate the new type of Adjustable Geometry Sensor (AGS). The new AGS sensor is aimed to expand the applicability of the Jazz-novo system, to subjects with extremely atypical "non standard in anatomical sense" geometrical relations of the nose bridge & eye cavity area. Jazz-novo Form-Size Factor has been improved, by integrating different functions previously distributed within several boxes (reducing their number), which led to powering it directly from the USB port. Better system packaging completes the list of Jazz-novo improvements.

The Jazz-novo Standard setup measures following signals:

- eye movements in the horizontal and vertical directions (1 kHz sampling frequency)
- head tilt in frontal and sagittal planes (1 kHz sampling frequency)
- total haemoglobin and oxyhaemoglobin plethysmography (500 Hz sampling frequency, 650/910 nm wave length)
- microphone signal (8 kHz sampling frequency, 12 bits sampling resolution)

The Jazz-novo Standard communicates with the host PC using an optical fibre link (optical system isolation) and USB connection.

The Jazz-novo Standard (basic system) can be enhanced by using the following options:

#### **Vestibulum option**

The Jazz-novo system can be equipped with two Uni-axial Rate Gyro (Vestibulum), which are used for measuring the velocity of head rotations about the vertical and horizontal axes. Redirecting of the gaze is usually coupled with involuntary head rotation toward the new gaze position. The gyroscopes provide the absolute values of the head rotation velocities and due to the existence of Vestibulo Ocular Response (VOR), can be used to cross calibrate the eye movement signals. The Vestibulo option adds following signals:

- velocity of horizontal head rotation (1 kHz sampling frequency, 12 bits sampling resolution,  $\pm 300^\circ/\text{s}$  measurement range)
- velocity of vertical head rotation (1 kHz sampling frequency, 12 bits sampling resolution,  $\pm 300^\circ/\text{s}$  measurement range)

#### **Autonomous recording option**

The Jazz system can also be used as a stand-alone system equipped with the battery powered controller and facility to record data on MMC flash memory card. It fulfils the function of a Hollter type device, allowing one to record whole-day eye and head activity. The idea behind it is that the visual interaction with the normal environment, like the working place or neurological rehabilitation clinic, provides the most natural visual stimuli. In this way ordinary daily activity can become the diagnostic experiment. The data recorder is equipped with automatic time stamping of the beginning and end of the recorded data file (the real time clock including the date).

#### **Wireless option**

Complementary to the autonomous recording option is the telemetry facility providing data transfer over a 2.4 Ghz short distance radio link. To name just one of the possible Jazz-novo applications, it allows the experimenter to monitor continuously the eye and head behaviour of the tested person, when he/she moves freely around the control room.

#### **Scene camera option**

Studying human operator behaviour often requires one to know the type of activity and situational context of the instantaneous operator engagement. To document it, Jazz-novo can be equipped with a scene camera, which – depending on the type of activity – can be attached by optical fibre or wireless transmission (2.4 GHz short distance radio link) to the external VCR or host PC.

#### **Synchronic option**

Jazz-novo with the synchronic option can perform the measurement synchronously with the external triggering signal. It can itself also provide the synchronising signal necessary to trigger other physiological-data acquisition systems or to synchronize two independent Jazz-novo measurement systems.

#### **Jazz-novo software**

The most important part of eye movement analysis is the separation of three types of eye movement signal changes, namely saccades, continuous "slow" eye movements and artefacts. In dynamic visual environment the continuous eye velocity, as well as the signal changes caused by the displacement of the eye movement sensor in relation to the eye and the eye blinks, can all approach typical saccadic velocities, making separation difficult. The software provided with Jazz-novo helps the user to carry this very central task of eye movement signal analysis. The original Jazz-novo data can be also exported to a text file for use in any commercially available analysis software.

#### **Acknowledgements**

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