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Saccadic Module

PRODUCT INSIGHTS

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This document provides a comprehensive overview of how to perform saccadic tests using the NYSTALYZE system in conjunction with the SYNAPSYS VNG Module Plus software. Unique for its adaptability, NYSTALYZE offers both a wireless mask and a wired version, catering to the diverse needs and preferences of users.

GENERAL CONCEPTS ABOUT SACCADES

The saccadic movements are the first of the tests that is normally performed and this since they form the basis of the visual calibration procedure. In fact, the accuracy of all subsequent measurements depends on the accuracy of the latter.

In order to perform the Saccadic test, it is essential to utilize the NYSTALYZE system, available in both wireless and wired camera configurations, within a controlled environment. The setup requires one eye (the "master") to focus on a target while the other eye (the "slave") is recorded under conditions of complete darkness.

The suggested saccade test is one with a constant amplitude of 40° (±20° in relation to the centre) and a pseudo-random rhythm. Indeed, it is known that working at constant amplitude reduces the variance of the results. On the other hand, the 20° angle allows the target to be kept within the limits of the retinal surface where peripheral vision is still supported by a large number of sensory cells. The variable duration of the fixation periods that follow one another in the predefined pseudo-random sequence was chosen so as not to surprise the elderly subjects and not to lower their state of vigilance. However, depending on the patient's age and psychological profile, it may be necessary to carry out a test with keyboard-controlled saccades in order to initially adapt to the patient's abilities; once this sort of training has been completed, the pseudo-random sequence can be proposed.

It is essential before starting the study of oculomotor skills with NYSTALYZE system to ask the patient if he is able to see the target frame well, i.e. that synthetic image which, projected on the screen, reproduces a central landmark surrounded by a rectangle whose edges are seen under the angle defined at the time of calibration. On the other hand, some patients have a tendency to rotate their head towards the sights and this causes an eye movement in the opposite direction. The examiner will then very often observe bilaterally hypermetric-looking saccades with a "pointed" conformation, i.e. not followed by a correction or re-fixation plateau. A simple glance at the patient's head will easily allow us to differentiate these aspects from true hypermetria. Also in this case, the correct use of the headrest, the patient's information regarding the test he is about to perform, and the continuous verification of the instructions given are fundamental.

In relation to the narrowness of the foveal cone of vision, the mechanisms for maintaining the eye on the position of a stationary point target are extremely effective. It follows that if a patient voluntarily fixes a target in order to project its image onto the fovea, it will not be possible to detect any eye movement, even at the resolution of the VNG which is 0.25°. The fixation plateau will then appear as a straight line even at the highest expansion coefficients of the temporo-spatial trace. Consequently, if the fixation plateau appears at the same time straight and of reproducible amplitude it means that all the conditions relating to vision, voluntary fixation and head immobility have been satisfied. In such a case, fortunately not rare, the VNG visual calibration procedure will have every chance of having great precision, since at this point it depends only on the mechanisms of conjugation that have been able to be verified previously.

But if the fixation plateaus are not stable, and the patient's good will does not appear to be in question, one can hypothesize either a deficit in the central vision of the master eye, or an alteration of the unilateral or bilateral extrinsic ocular musculature, or even a previously undetected conjugation defect. In this case it is impossible to carry out the calibration under VNG and, consequently, it will be necessary to resort to geometric calibration or, better yet, to explore oculomotor skills using a free field mask.

The previous considerations have led us to evaluate various situations in which vision or ocular motility are altered in such a way that the visual calibration procedure, i.e. the one which is carried out using sights arranged according to a known angle, becomes unfeasible with the mask in a closed field. However, a visual calibration that is impossible to achieve in the master eye-slave eye (VNG) mode can be accomplished using a binocular mask in an open field of view (VOG). For example, unilateral blindness with preservation of the external appearance of the eye and without abnormalities of its motility does not pose any problem for a study with a VOG mask, as the seeing eye is sufficient to fix the sights. On the other hand, there are circumstances, such as bilateral blindness, where not even VOG allows for precise visual calibration. Further types of calibration have therefore been studied that allow overcoming these difficulties.

Note: If you cannot carry out a visual calibration (paralysis or other reason), the absolute measurements will be adversely affected by an error (<20% in 95% of cases). However, the relative measurements will remain accurate and will not therefore lead to an error in a caloric test. The error in the absolute measurements can be reduced by carrying out geometric calibration.

PATIENT INSTRUCTIONS

Before starting the exam with NYSTALYZE system it is necessary to provide some simple instructions to the patient. Place your head so that you can see both edges of the framing guide (the framing guide is visible when the eye window is closed). Do not move the head for following the target. Avoid any head tilt, pitch, roll before and during the test. Look carefully exactly at the centre of the target, not its immediate surroundings. Move your gaze immediately after the target changes position on the screen, avoid early or late movements.

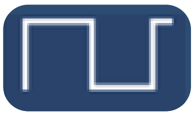
INTERPRETATION OF SACCADIC TEST

It is necessary:

- Check the height identity between the patient's eyes and the target.
- Ensure good linearity of the fixation plateau (paying attention to the presence of square waves due to inaccuracy or pathological type, of a fixation Ny, of blinking and of eye closure, of the instability of the centring in the lateral positions of gaze and of heterophoria of the slave eye).
- Eliminate incorrect saccades or other artifact from the evaluation window (i.e., those that are advanced or delayed, those that present inappropriate stops along the aiming path, those with inconsistent amplitude).

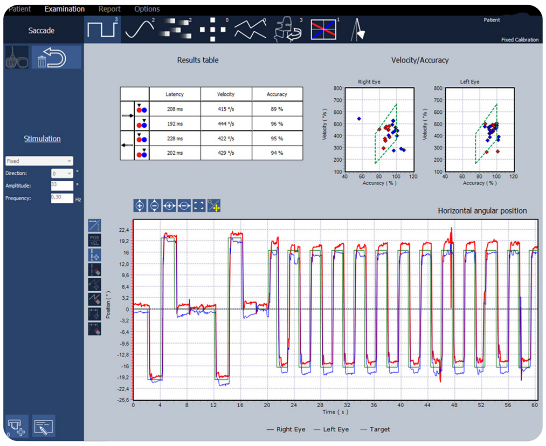
GENERAL PRESENTATION OF SACCADE MODULE

The saccade module is represented by the icon:

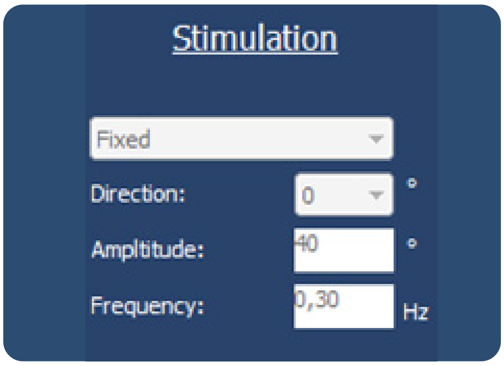


This module allows the visual targets required for the saccade test to be generated and allows the corresponding voluntary ocular motor responses to be recorded and analysed.

In addition to the saccade test, this module also allows visual calibration of the ocular eye displacement measurements.



STIMULATION PARAMETERS:



• Type of stimulation:

Fixed: squared sequence, constant amplitude and frequency

Random Frequency: sequence with constant amplitudes and variable frequencies

Random frequency and amplification: sequence with variable amplitudes and frequencies

- Direction: direction of stimulation (0= horizontal, 90 = vertical, 30 =oblique)
- Amplitude: angular amplitude of saccade shots.
- Frequency: frequency of stimulation

FIXED SQUARED SEQUENCE

This test is the simplest form of saccade test. The rhythm of the saccades and the amplitude correspond to those declared in the parametrisation menu. Although it is open to criticism because of its regular rhythm, which quickly makes the movement “predictable”, this test is still however especially useful for calibration of high-precision amplitude.

RANDOM FREQUENCY (FREYSS SEQUENCE)

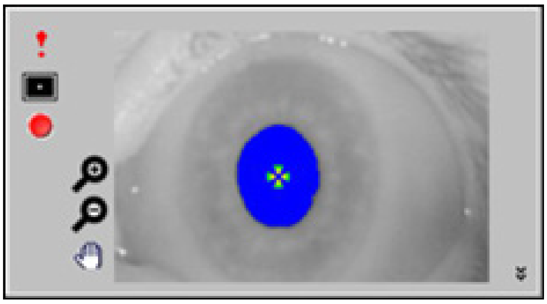
The Freyss sequence is a sequence of pseudo-random period and fixed amplitude of +/-20° in relation to the centre. The sequence was defined by Professor Georges Freyss in order to include sequences of deflections of 40° set apart by variable spaces of time according to a pre-defined sequence. Each of these elementary time periods is not so long that vigilance is reduced, or so short that account cannot be taken of the subjects’ reaction time including age or disease allowances. The fixed amplitude was preferred over the variable amplitude because it reduces the variation of the results, while the value of +/-20° is optimal in terms of conditions of peripheral vision.

RANDOM FREQUENCY AND AMPLITUDE SEQUENCE

With NYSTALYZE system the user will be able to define a test in which he/she will use a pseudo-random test or any other test at his/her convenience by creating a personalised sequence.

CALIBRATION STAGE

If you have not carried out a calibration for this patient (icon of red exclamation mark is present), a saccade shot test will begin with a stage of visual calibration of measurements. The visual calibration is complete when the icon is replaced with .



DISPLAY OF RESULTS

The results are displayed in a table and in diagrams.

The user can choose between two types of result diagram for the saccade module: the "velocity/precision" diagrams and the "velocity/amplitude" diagrams.

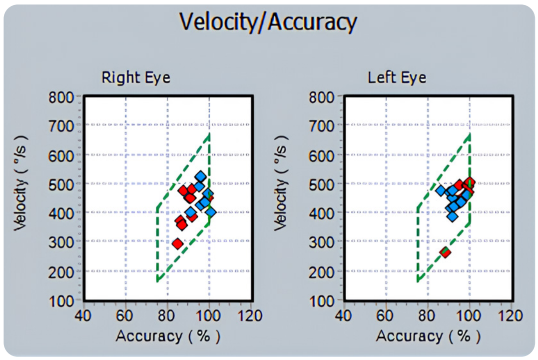
The results displayed correspond to the zone displayed in the position graph: only the saccades visible on the position graph are taken into account with constructing the results diagrams and results table.

	Saccade towards right
	Saccade towards left
	Right eye
	Left eye

		Latency	Velocity	Accuracy
		257 ms	388 °/s	93 %
		258 ms	439 °/s	100 %
		245 ms	453 °/s	97 %
		244 ms	393 °/s	89 %

The last table shows numerical values of the latencies, velocities, and accuracy of the saccade to the left and to the right. For each of these three parameters, it is the average calculated taking account of all the saccades shown on the graph and correlated to the stimulation.

VELOCITY/PRECISION DIAGRAMS



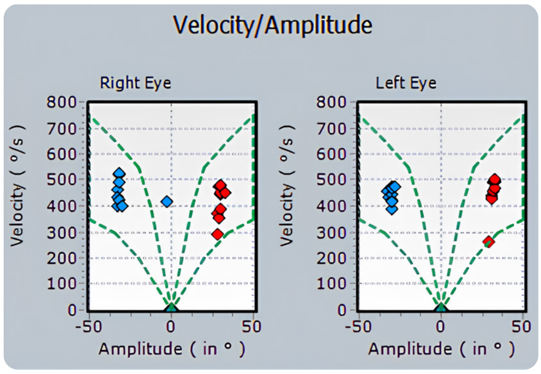
The saccades are shown using coloured patches on this diagram.

The coordinates of the points correspond to the velocity and precision of each saccade.

The patch is red if the saccade is directed to the right and blue if it is directed to the left.

The area dotted in green represents the standard zone.

VELOCITY/AMPLITUDE DIAGRAM



The saccades are shown using coloured patches on this diagram.

The coordinates of the points correspond to the velocity and amplitude of each saccade.

The patch is red if the saccade is directed to the right and blue if it is directed to the left.

The area dotted in green represents the standard zone.

NORMATIVE VALUES ABOUT SACCADES

With NYSTALYZE system for the saccadic module when the visualization of normative data is enabled, reference tables appear. It is important to underline how the normative data can in fact be modified by the user and are associated with the patient's age groups. The tabular results of the tests, if the "Highlight normal/abnormal values" option is enabled from the VNG settings, appear in green or orange, depending on the normative data that have been set.

The normative parameters of the VNG were drawn from the volume "*Balance function assessment and management – third edition – Gary P. Jacobson, neil T. Shepard*".

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