



RA816 biological analyser

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The benchtop system that redefines tissue and biofluid analysis

Renishaw's RA816 biological analyser is a compact benchtop Raman imaging system that redefines tissue and biofluid analysis. It is easy to use, yet gives rich biochemical information about the biological samples being analysed.

Designed exclusively for the biological sciences community, the system rapidly obtains detailed information on the distribution and amount of biochemical species within biological samples, including tissue biopsies, tissue sections and biofluids.

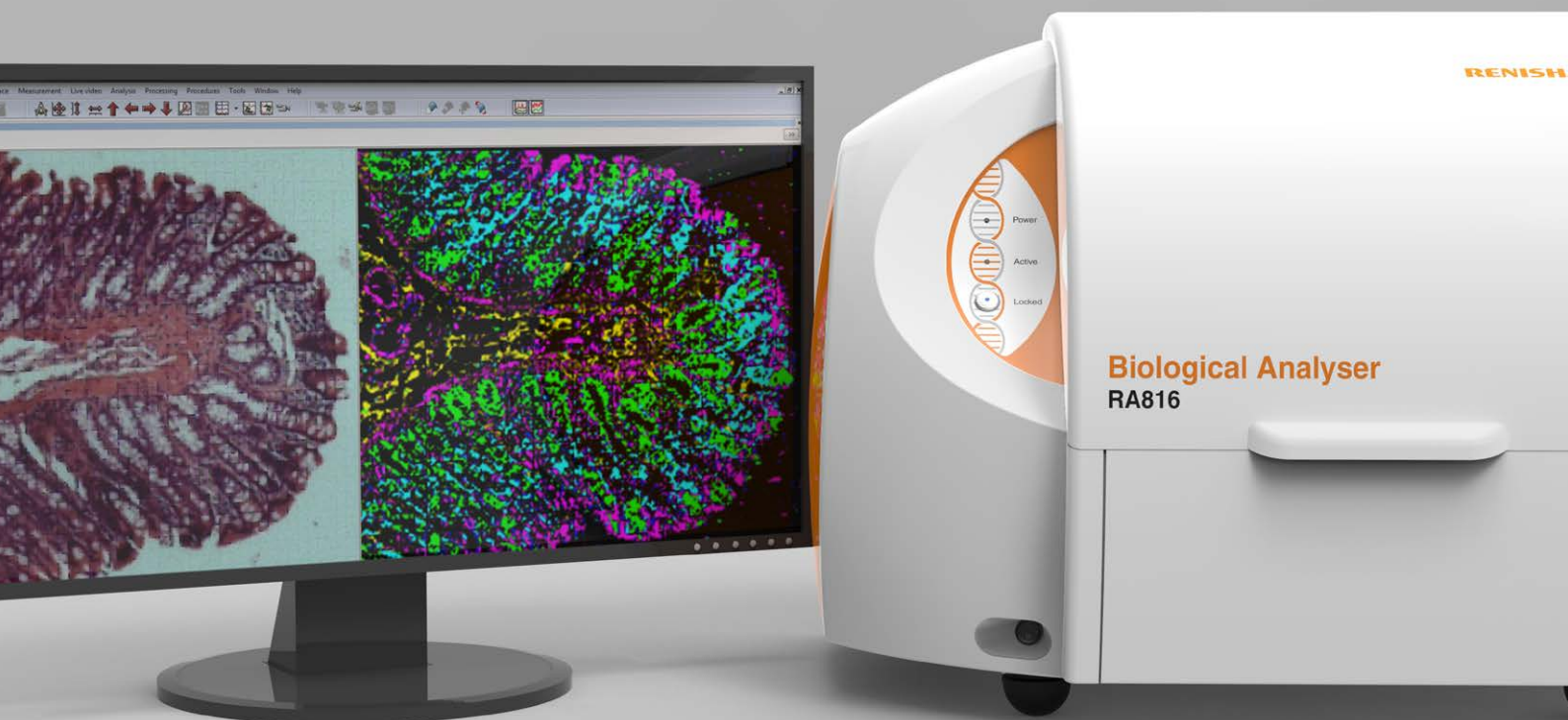
The RA816 biological analyser brings together the chemical analysis power of Raman spectroscopy (a light scattering technique) and advanced optical and spectroscopic imaging technologies in a simple, robust system. It produces outstanding results, quickly and easily.

Raman spectroscopy provides many benefits for the study of biological materials:

- Non-invasive optical technique (retains sample integrity).
- Measures multiple molecular constituents in biological samples at once (saves cost and time).
- No sample staining or labelling required.
- High specificity: aids in discovery and validation of early onset disease markers.
- The generated high-resolution Raman images provide both biomolecular and morphology information.



Detailed biochemical information is revealed from biological samples. From the distribution of exogenous and endogenous compounds within tissue, to the detection of protein secondary structure changes due to drug interaction and tissue injury.



Bringing Raman into the clinic laboratory

The RA816 biological analyser has a range of features making it the ideal tool for clinical research

Easy to use

- Easy to use software with simple concept and workflow: making Raman spectroscopy accessible to all users, without compromising performance.
- Macro and high magnification imaging modes, with digital zooming for a range of sample sizes.
- Reflection or transmission illumination for best image contrast.
- Image tiling for large area coverage.

Compact, robust and transportable

- Small footprint - ideal for a space-conscious laboratory environment.
- System can be easily moved between lab and clinic with inbuilt performance checking to ensure accuracy.
- Robust system that does not require user alignment.

High performance for demanding applications

- Stable and repeatable, with integrated performance qualification (PQ) and alignment.
- Post measurement check option to validate performance stability over the measurement period.
- High throughput with high signal-to-noise spectral data and optimised substrates.
- LiveTrack™ technology to track sample surface and retain focus.
- Streamline™ technology for high speed data collection and image generation, without causing laser sample damage.

Dedicated data acquisition and analysis software

- Experiment templates for different biological sample types to simplify operation.
- Model building software for clinical data classification:
 - provides the ability to build and validate pathology and disease models.
 - validate the model with new samples enabling the stratification and classification of unknown tissue and biofluid samples.
- Optimal system and sample workflow: enables robust, repeatable and reproducible data to be collected and analysed.
- Enable configuration of multiple measurements for unattended operation.

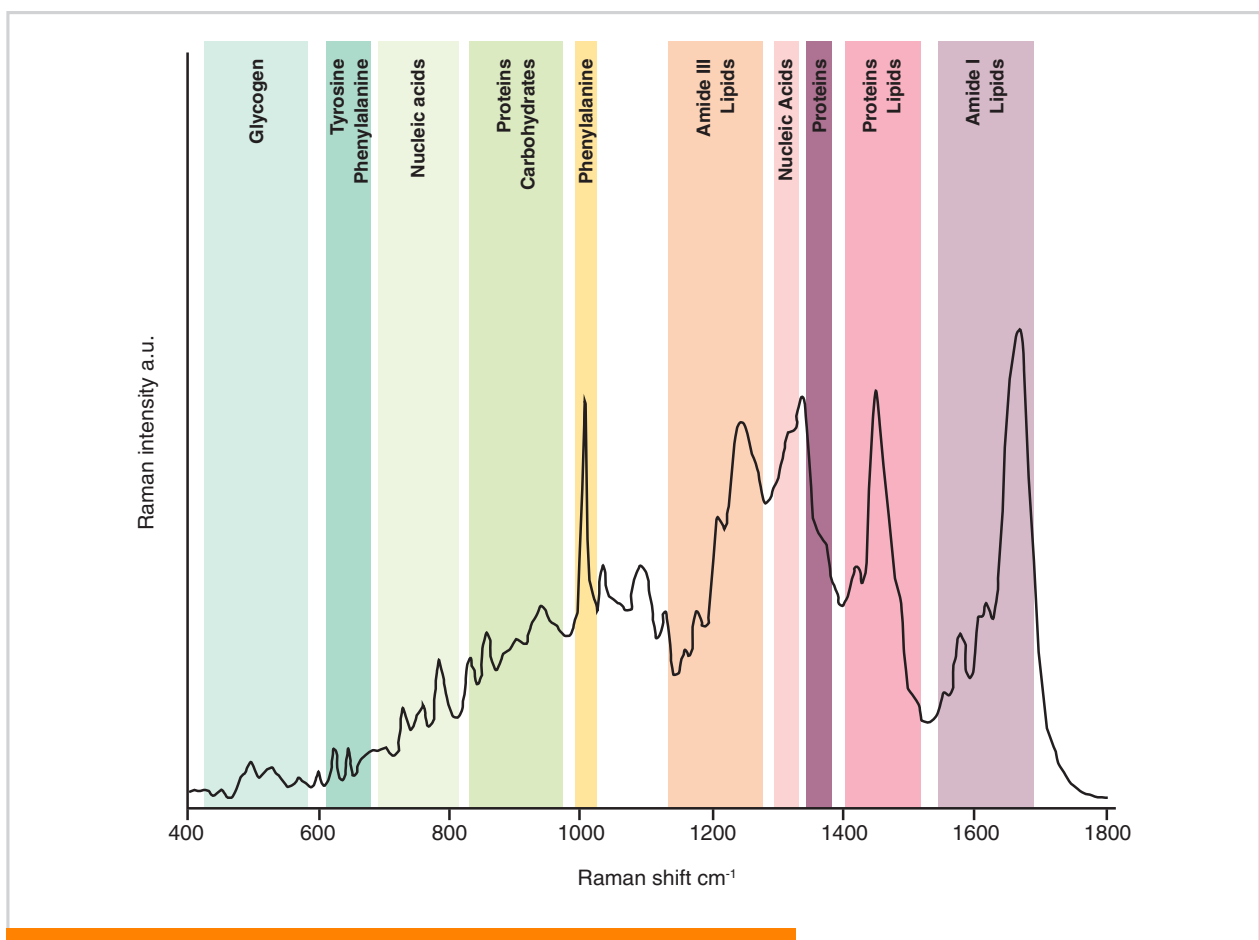
The ideal toolkit for translating Raman to the clinic

- Performance standards support data transferability of classification models to additional Renishaw biological analyser systems.
- Specially designed bio-sample holders and inserts for bio-fluids/liquids and tissue sections.
- Bulk tissue biopsy sample holder eliminates the need for tissue sample preparation (e.g. cryosectioning or microtoming).
- Low-cost, ultra-low background reusable mirror slides for enhanced reflection, to increase Raman signal and improve white light contrast.



A range of specially designed sample holders.





A typical biological tissue Raman spectrum. It demonstrates the wealth of information obtained from a single measurement.



Powerful software

Data acquisition

The RA816 biological analyser is entirely computer-controlled. Its software provides a structure for managing every step of the measurement process using pre-defined experiment setups and protocols. The unique macro image provides a comprehensive overview of all subsequent work and enables easy sample navigation and visualisation.

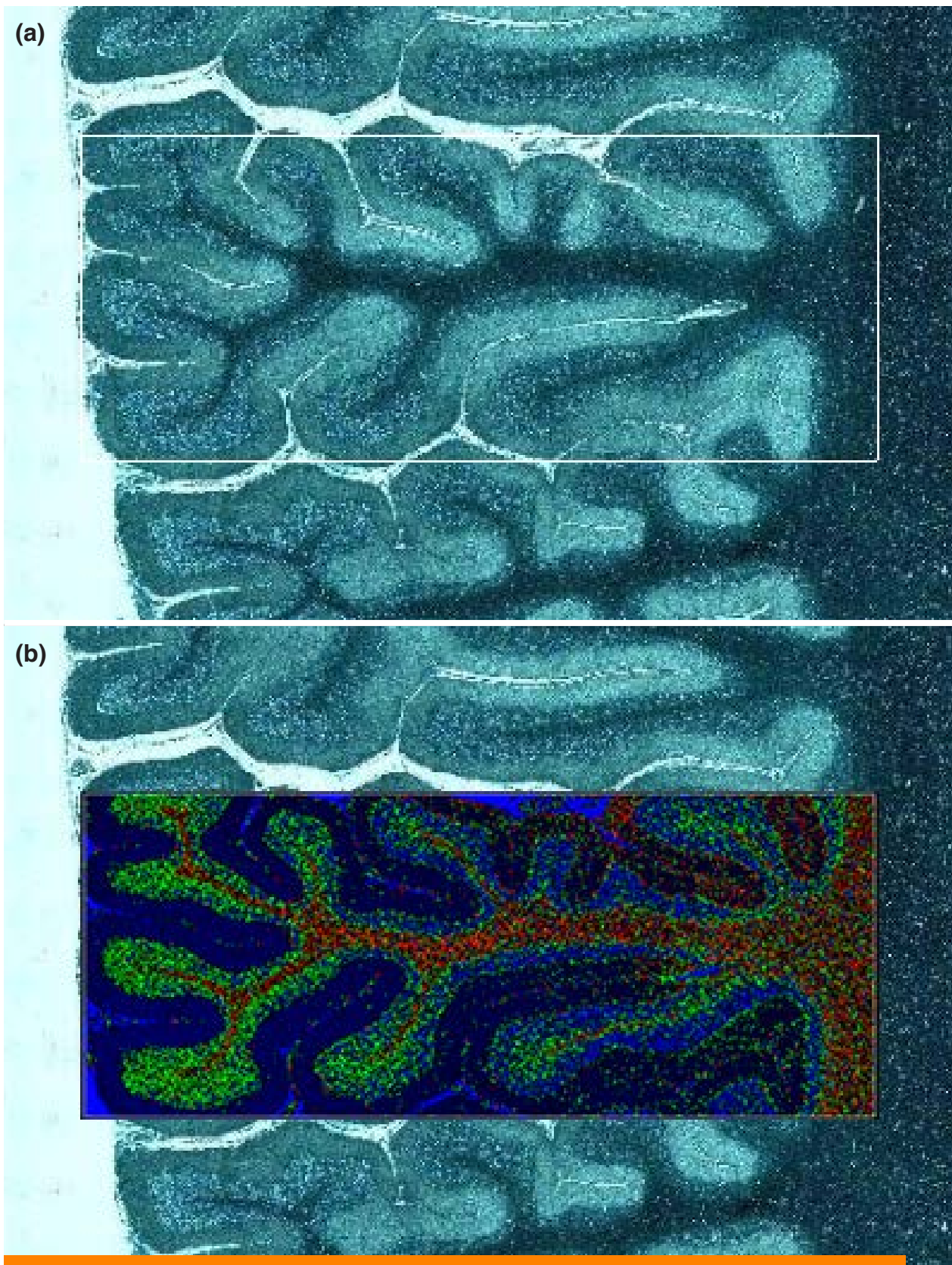
The system can acquire data unattended. Its queuing capability enables you to configure measurements and leave the instrument to run them; you can analyse multiple samples on a slide without the need for user intervention.

Building and validating a classification model

The system includes a software package that enables the user to:

- Process spectral datasets.
- Build, test and validate pathology and disease classification models (using PCA-LDA).
- Minimise instrument and sample quality variations within and between the instruments and sites.
- Test and validate classification models with new independent sample data.

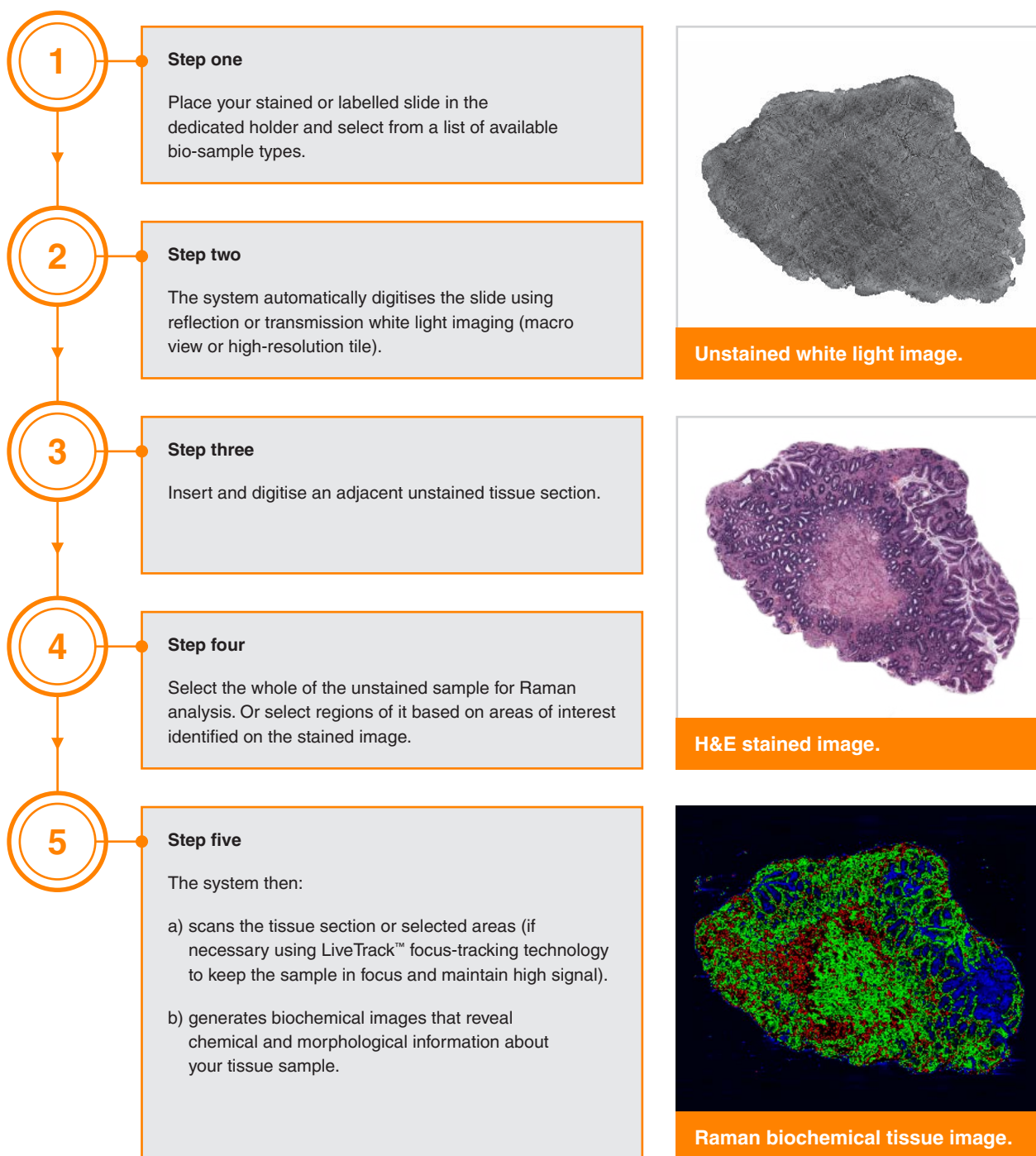
These tools aid in the discrimination of cancer stages with high sensitivity and specificity, establish early onset disease markers and identify biochemical changes associated with cancer formation and progression.



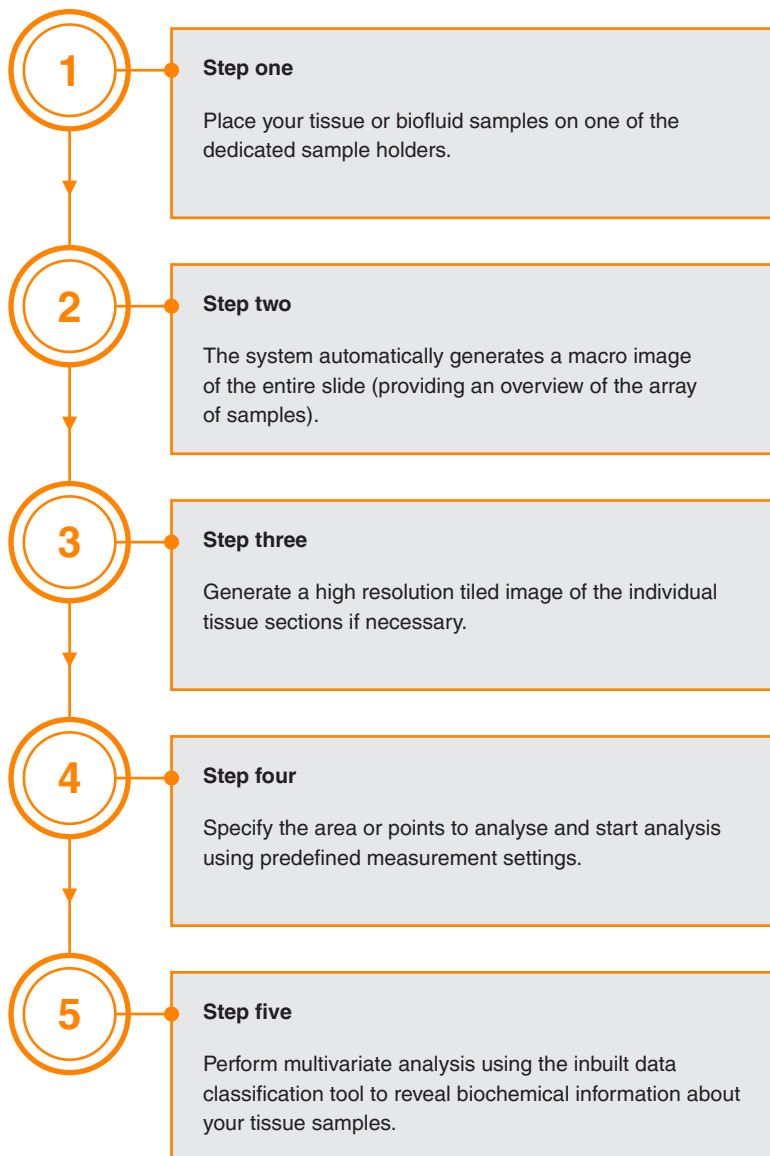
Imaging human brain tissue. Comparison of (a) white light and (b) Raman-false-coloured composite image of a cerebellum whole follicle, showing arbor vitae / white matter (red), granule cell layer (green), molecular layer (dark blue) and meninges (pia, arachnoid and dura mater) (cyan).

Example workflows for routine operation

Raman tissue imaging with the RA816 biological analyser and correlating results with stained or labelled slides



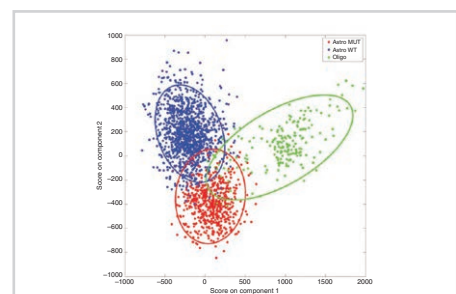
Raman spectral data collection for disease and pathology classification



Macro image of slide.



Mean of example spectral dataset.



Example: Multivariate analysis (PCA-LDA) of the IDH genomic mutation status of brain glioma.

Example: Sensitivity and specificity for predicting genetic subtypes using pc-linear discriminant analysis (LDA) 3-group and 2-group models for fresh tissue samples, cryosections, and formalin-fixed paraffin-embedded (FFPE) sections^{*1}

Model	Genetic subtypes	Fresh tissue		Cryosections		FFPE sections	
		Sensitivity	Specificity	Sensitivity	Specificity	Sensitivity	Specificity
3-group	Astrocytoma, IDH-wild-type	0.94	0.90	0.78	0.85	0.81	0.84
	Astrocytoma, IDH-mutant	0.91	0.95	0.79	0.89	0.72	0.87
	Oligodendroglioma	0.79	1.00	0.74	0.90	0.79	0.93
2-group	IDH-wild-type	0.95	0.91	0.88	0.83	0.77	0.71
	IDH-mutant	0.91	0.95	0.83	0.88	0.71	0.77

^{*1} Laurent James Livermore et al, Rapid intraoperative molecular genetic classification of gliomas using Raman spectroscopy, Neuro-Oncology Advances, Volume 1, Issue 1, May-December 2019, vdz008, <https://doi.org/10.1093/noajnl/vdz008>

Technical highlights: RA816 biological analyser

Parameter	Value
Laser wavelength	785 nm Integral Renishaw high power near-infrared diode laser, 300 mW at 785 nm, air cooled, with integral plasma filter. Laser power: > 150 mW at sample. Innovative StreamLine technology enables higher laser power use without sample damage.
Spectral range	100 cm ⁻¹ to 3250 cm ⁻¹ Performed in two separate scan ranges Range 1: 100 cm ⁻¹ to 2000 cm ⁻¹ ; Range 2: 1950 cm ⁻¹ to 3250 cm ⁻¹
Spectral dispersion	2 cm ⁻¹ pixel ⁻¹
Data collection speed	Over 1500 spectra/s
Minimum Raman image pixel size (spatial resolution)	1 µm
Objective	8.2 mm working distance 0.55 NA 50× long working distance objective Additional macro-view colour video camera
Field of view	Macro 21 mm × 16 mm Micro 330 µm × 250 µm
Maximum tiled image size	Macro 134 mm × 76 mm High magnification 112 mm × 81 mm
White light modes	White light transmission and reflection capability
Focusing	Macro – Manual or pre-defined Micro – Automatic (LiveTrack) or manual Real-time automated LiveTrack dynamic focusing for both Raman data acquisition and white light video viewing modes
System calibration and transferability	Self-calibration and auto-align using built-in neon and silicon references Automatic PQ data collection (polystyrene) Optional post measurement check (PMC) for inter-measurement validation
Maximum sample size	~ (110 mm × 90 mm × 25 mm) – fits 96-well plate
Power, voltage	100 – 240 VAC ± 10%, 50/60 Hz, 100 W maximum
Dimensions	720 mm (W) × 502 mm (H) × 535 mm (D)
Mass (not including computer)	54 kg
Laser class	Class 1 laser product complies with IEC60825-1. CE marked

The RA816 biological analyser is designed for research use only (RUO) and is not for use in diagnostic procedures.

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