



UCD Conway Institute



Cutting edge technologies serving
research in academia and industry

conway.ucd.ie/coretech

CORE TECHNOLOGIES

AT UCD CONWAY INSTITUTE



The UCD Conway core technologies programme is the most comprehensive and advanced analysis platform for the life sciences and biomedical research in Ireland. Our suite of modern genomics, proteomics, cytometry and imaging technologies allows us to offer bespoke project design and seamless analysis across several experimental platforms. As a result, we can deliver comprehensive solutions to challenging research questions for our academic and industrial partners.

Our staff are highly skilled researchers who will help with all aspects of project planning, execution and downstream data analysis. The programme relies on a dedicated team of scientists and technical staff whose joint expertise covers the broad range of knowledge and experience that ensures that our clients get the best quality service and the most out of their data. Our core technology staff will focus on your research question with a 'problem solving' approach to finding the best-fit solution for your particular research needs. Once the data is generated we can help with the downstream analysis as needed.

Providing technology solutions to 21st century research questions.

We continue to invest in both infrastructure and instrumentation to ensure our core technology programme remains cutting edge. These resources are dedicated to serve the scientific community; both academic and commercial, in Ireland and abroad. Details of each of our technologies are summarised here and our Technology Directors and staff can be contacted at any time to discuss your particular application and would be happy to arrange a visit to the UCD Conway core technology laboratories.

Professor Walter Kolch

Director, UCD Conway Institute

Our clients include:

- Alltech
- BD Accuri
- Beckman Coulter
- Chemometech
- Java Clinical Research Ltd
- Pfizer
- Radisens Diagnostics
- Shire
- Trinity Biotech
- National Institute for Bioprocessing Research & Training

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Genomics



**Affymetrix GeneChip
Microarray Platform**

Real Time PCR

**Illumina Sequencing
Platform**

Bioinformatics

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Director's Introduction

Genomics is one of the most exciting and fruitful areas of research in the 21st century. Sequencing an organism's genome and the output of its genes can be used to determine which changes in a genome are harmful or pathogenic and how an organism responds to disease or stimuli. We have a range of facilities for next-generation sequencing, real-time PCR and microarray analysis as well as offering custom bioinformatics analysis.

Our core technologies have been leveraged in a wide range of large human disease studies; on a variety of microbial pathogens either to measure response or following an outbreak; and even on ancient DNA extracted from fossil specimens.

We have been offering genomics solutions to academic and commercial customers for more than 10 years in a customisable range of services for each stage of the research pathway, from experimental design and strategy to final publication.

Education

Our team are involved in the delivery of both accredited graduate and continuing professional development modules to scientists involved in genomic research.

CNWX40090 Introduction to 'Omics' & Advanced Imaging Technologies
CNWX40150 Genomics –Principles & Practice

Details: <http://www.ucd.ie/conway/education/>

Affymetrix GeneChip Microarray Platform

The Affymetrix GeneChip microarray platform consists of high-density microarrays and tools to process and analyse them, including standardised assays and reagents, instrumentation, and data management and analysis tools.

GeneChip microarrays consist of small DNA fragments known as probes, chemically synthesised at specific locations on a coated quartz surface. The precise location where each probe is synthesised is called a feature, and millions of features can be contained on one array.

Applications:

By extracting and labelling nucleic acids from experimental samples and then hybridising those prepared samples to the array, the amount of label can be monitored at each feature, enabling a wide range of applications on a whole-genome scale including gene- and exon-level expression analysis, novel transcript delivery, genotyping and resequencing. Microarray analysis can also be combined with chromatin immunoprecipitation to perform genome-wide identification of transcription factors and their respective binding sites.

Instrumentation:

- GeneChip 3000 7G scanner
- Automated fluidics 450 station
- Hybridisation oven
- GeneChip workstation with AGCC software
- Agilent bioanalyser
- Nanodrop spectrophotometer

Expertise & Services:

- Initial meeting to discuss experimental design and strategy
- Advice on sample preparation and provision of protocols
- Sample preparation and labelling service
- Quality assessment of total RNA and cRNA
- Array hybridisation, washing, staining & scanning
- Assessment & monitoring of array quality
- Primary data analysis, provision of QC report and raw data files



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Real Time PCR

Real-Time PCR is a powerful and sensitive technique for detection and quantification of specific nucleic acid sequences. It monitors the polymerase chain reaction (PCR) as it occurs and characterises samples at the point of initial amplification of PCR product rather than the amount accumulated after a fixed number of cycles. The higher the starting copy number of target sequence, the sooner its PCR product is detected.

Application:

Both relative and absolute quantitative analysis may be investigated. Relative quantification provides comparative measurement of target across a set of biological samples and is used in applications such as gene expression profiling, microRNA and siRNA studies. Absolute quantification assigns values of target to samples from external standards and examples include copy number determination and viral load measurement. This technology may also be used in conjunction with end-point reads for allelic discrimination or SNP detection.

Instrumentation:

Two ABI 7900HT Sequence Detection Systems are in operation in this facility comprising:

- Primer Express Software v2.0 (primer and probe assay design)
- Interchangeable thermal cycling blocks (Fast and Standard)
- Laser and CCD camera detector (fluorescence induction and data collection)
- Sequence Detection Software v2.4 (instrument operation and data analysis)

Samples are run on 96- and 384-well plates or microfluidic cards with Taqman probe or Sybr Green based fluorescent assays. These assays are designed and optimised or purchased commercially in pre-optimised single tubes or array formats for higher throughput experiments.

Expertise & Services:

The Real-Time PCR core facility provides a range of technical services to researchers including:

- Consultation on experimental design
- Assay design and ordering
- Training on sample set-up, instrumentation and data interpretation
- Sample running service, if required
- Results analysis

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Illumina Sequencing Platform

The Illumina sequencing platform is used for a variety of genomics/transcriptomics and epigenomics studies. The system utilises reversible terminator chemistry, to deliver high levels of accuracy, cost effectiveness and throughput. Users include research centres, pharmaceutical companies, academic institutions, clinical research organisations and biotechnology companies.

Applications:

The platform supports a diverse range of applications including RNA-Seq, digital gene expression, whole genome and candidate region sequencing, DNA-protein interaction profiling and small RNA identification.

Expertise & Services:

We provide a range of technical services and expertise in this area including:

- Discussions on the suitability of the platform, experimental design and strategy
- Advice on sample preparation and provision of protocols
- Sample QC, library preparation, cluster generation and sequencing
- Preliminary data analysis to generate aligned sequence, if genome is known
- Provision of FASTA Q and/or other data files for further analysis
- Downstream bioinformatics analysis, on request



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Bioinformatics

Modern high throughput technologies have changed the way many experiments are designed and interpreted. Understanding the technologies is paramount in the design of effective experimental strategies. When high-throughput raw data is generated, specialist analytical techniques must be applied to produce valid results for subsequent biological interpretation.

UCD Conway Institute provides the opportunity for 'wet-lab' biologists to interact with bioinformaticians at various points along the pathway from an experimental idea to final publication.



Expertise & Services:

Bioinformatics support is available in the Genomics Core facility. We have a wealth of experience in many facets of data handling for genomics and transcriptomics, extending to over 20 years of DNA sequencing and analysis. Genomics Core facility analysis is provided in the following areas:

- mRNA seq
- ChIP seq
- Prokaryotic genome sequencing
- Affymetrix gene expression arrays

Quality control and primary analysis of the data is provided for all projects. Custom analysis including functional mapping and pathway analysis is also available.

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“

Service was excellent - much faster and more efficient than our previous experience using a commercial company - and it was invaluable to have access to the scientists doing the sequencing and bioinformatic analysis.

Dr Jim O’Gara,
UCD

”

Proteomics



Protein Separations Laboratory

Mass Spectrometry Resource

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Director's Introduction

Proteomics is the large scale study of proteins and their modifications that play important roles in the fundamental biology of health and disease.

The facility includes a protein separations laboratory and dedicated biological mass spectrometry resource. Mass spectrometry is an analytical technique capable of accurately determining the mass, charge and chemical structures of molecules. It is now possible to apply mass spectrometry to macromolecules of biological interest like nucleic acids and proteins.

Our instrumentation is capable of covering all aspects of modern proteomic science including quantitative proteomics, protein post-translational modifications and protein-protein interactions. We work on an exciting range of commercial and academic research projects from mechanistic insights into HIV replication to reproductive biology in humans and animals to nanomedicine and nanotoxicology.

We offer the dedicated strategic support of our team, both on the analytical and bioinformatics side, to enable our research and commercial partners to take full advantage of their results.

Education

Our team are involved in the delivery of both accredited graduate and continuing professional development modules to scientists involved in proteomic research.
CNWY40090 Introduction to 'Omics' & Advanced Imaging Technologies
CNWY40140 Emerging 'Omic' Technologies
CNWY40160 Applied Proteomics

Details: <http://www.ucd.ie/conway/education/>

Protein Separations Laboratory

The Protein Separations Laboratory is a facility dedicated to electrophoretic gel separation of proteins prior to their identification by downstream mass spectrometric analysis, with particular expertise in the running and subsequent analysis of large format 2D-DIGE gels.

Instrumentation:

Full equipment for protein separation by 2-D gel electrophoresis (2-DE) including

- IPGphorII and IPGphor3
- Ettan Dalt 6 and 12
- BioRad Protean Plus Dodeca cell

Imagers (both visible and fluorescent)

- Typhoon 9410 variable mode imager (for 2D-DIGE)
- BioRad GS800

Image Analysis software

- Progenesis SameSpots v4
- DeCyder v6

Expertise & Services:

The Protein Separations Laboratory provides expertise and full training in two dimensional gel electrophoresis (2D-E)

- Advice on experimental design for 2D-DIGE
- Sample preparation for 2-DE and 2D-DIGE (including fluorescent labelling for DIGE)
- Full training in all aspects of running 2-DE (both mini and large formats)
- Training on Typhoon variable imager
- Training on image analysis software and interpretation of results



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Mass Spectrometry Resource

The Mass Spectrometry Resource is a state-of-the-art biologic mass spectrometry facility providing access to all the necessary instrumentation for high-throughput, high accuracy protein identification, quantification and characterisation.

Instrumentation:

In terms of equipment, MSR avails of several mass spectrometers in order to be able to cover almost all possible experimental workflows in mass spectrometry-based proteomics. These include:

- Thermo Fisher Q-Exactive
- Thermo Fisher Orbitrap
- Thermo Fisher LTQ ion trap
- Agilent 6520 Quadrupole-ToF
- Agilent 6460 Triple Quadrupole
- ABI 4800 Ultra MALDI/ToF-ToF with CovalX HM2 high-mass range detector
- Bruker HCTUltra II ETD ion trap.

The AB Sciex 4800 MALDI-ToF/ToF mass spectrometer with a CovalX HM2 high mass-range detector is applied to gel-based and off-line liquid chromatography (LC)-based, high throughput MALDI-MS/MS proteomic workflows or, in linear mode, to accurate determination of the mass of intact proteins or protein complexes up to 1.2 Megadaltons.

The Q-Exactive, LTQ-Orbitrap, the ion traps, the quadrupole time-of-flight and a triple quadrupole mass spectrometers cover all possible needs in liquid-chromatography-tandem mass spectrometry.

Furthermore, the MSR offers access to LC-based workflows supporting the multi-dimensional protein identification technology (MudPIT) and a nano-LC system coupled to a MALDI target loading robot to support off-line LC MALDI-MS.

Software Suite:

Raw data files generated by each mass spectrometer are subjected to database search with the appropriate algorithm (Mascot, TurboSequest, Spectrum Mill) and database.



Expertise & Services:

- Discussions on the suitability of the platform, experimental design and strategy
- Sample running service
- Access to state-of-art software suite (Peaks Studio, MaxQuant) for protein identification (de novo sequencing and database matching), quantitation and PTM characterisation
- Custom analysis
- Mass spectrometry software training
- Sample preparation training: a two-day module is offered that includes band cutting from gels, in-gel tryptic digestion, in-solution digestion and peptide purification by RP ZipTips.



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Imaging



Director's Introduction

We focus on providing contemporary imaging technologies and know-how to researchers in the wider Irish scientific community; both in academia and industry.

Our consolidated instrumentation suite spans all aspects of light and electron microscopy as well as sample preparation and image processing and analysis facilities. We use our technical expertise to assist in the widest possible range of applications for microscopy, in advancing the development of new applications and indeed new imaging technologies.

We work with a wide range of researchers on diverse applications from retinal disease, clinical viral diagnostics, nanoparticle-cell interaction and toxicity, pharmaceutical development to food quality control and development.

We provide expert advice on translating a scientific problem in imaging into practical research plans and supporting our users until the point of publication. By adopting a problem-solving approach, we can help our clients find a microscopy solution that works for their research; simply, accurately and quickly.

Education

Our team are involved in the delivery of both accredited graduate and continuing professional development modules to scientists interested in using imaging technologies within their research.

CNWX40090 Introduction to 'Omics' & Advanced Imaging Technologies
CNWX40120 Advanced Biological Imaging
CNWX40170 Fundamental Biological Imaging

Details: <http://www.ucd.ie/conway/education/>

**Histological
Sample Preparation
Electron Microscopy
Light Microscopy
Digital Pathology**

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Director, Imaging Core

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Histological Sample Preparation

The facility provides for all aspects of tissue histology from processing of formalin fixed tissue, paraffin embedding and sectioning to automated staining and automated coverslipping of stained slides. These slides can be converted to digital images and analysed either using the Aperio slide scanner or using light or electron microscopy.

Instrumentation:

- Tissue Tek VIV E 300processor
- Leica EG1150H
- Several microtomes
- Automatic stainer Leica XL
- Automatic coverslipper LeicaCV5030
- Labvision pre-treatment (PT) module
- Multiheaded microscope

Expertise & Services:

- Processing, paraffin embedding, sectioning and production of slides for staining
- Routine Haematoxylin and Eosin (H&E) staining with facilities to programme for special stains
- Automated coverslipping
- Training in all aspects listed above



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For Digital Pathology:

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Electron Microscopy

Image resolution in light microscopy is limited by the wavelength of light and is incapable of resolving structures of less than 200 nm. However, the resolution of electron microscopy limited by biological sample preparation goes beyond 1 nm.

Transmission Electron Microscopy (TEM) is used to investigate ultrastructure of thin samples (limited by the penetration of electron beam): flat cells, nano-particles, biological tissues embedded into polymers etc.

Scanning Electron Microscopy (SEM) is used to investigate fine structure on surfaces of biological and non-biological objects.

Applications:

Research topics include detection of viruses for human patients, inflammation, oncology, cardiovascular biology, morphology of zebrafish retina, bacteriology, food sciences, polymer films for biosensors, nano-particle toxicity in vitro and artificial joints.

Instrumentation:

- Three transmission electron microscopes (TEM)
- One scanning electron microscope (SEM)
- Three ultramicrotomes, including one suitable for cryo-ultramicrotomy
- Fume hood, oven for EPON embedding and other TEM sample preparation instruments
- Critical point dryer, gold/carbon coater and other EM sample preparation instruments
- Light microscopes for EM sample preparation

Expertise & Services:

- Experimental strategy, technology choice and planning
- Sample preparation: TEM and SEM
- Image acquisition: TEM and SEM
- Image analysis, including EM tomography
- Training in sample preparation, imaging and image analysis

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Light Microscopy

Our instrumentation suite covers the widest range of light microscopy requirements including:

Transmission light microscopy:

- Bright field
- Dark field
- Phase contrast
- Polarized light
- Differential interference contrast (DIC)

Fluorescent microscopy

- Epi-fluorescence
- Laser confocal (single pinhole)
- Spinning disc confocal
- Fluorescence resonance energy transfer (FRET)
- Fluorescence-lifetime imaging microscopy (FLIM)
- Fluorescence recovery after photobleaching (FRAP)
- Photoactivation
- Total internal reflection fluorescence (TIRF)
- FRET/FLIM TIRF confocal microscope

Reflected light microscopy

Applications:

Research topics include oncology, dermatology, cardiology, biology of worms, insects and zebrafish as well as nano-biology. We can discuss your requirements for the imaging of native, stained or immunolabelled cells or tissue sections, time lapse imaging of live cells and Z-stack acquisition for 3D microscopy.

Expertise & Services:

- Image acquisition
- Image analysis
- Training in
 - sample preparation
 - imaging: transmission, fluorescent, confocal and live cell microscopy
 - image analysis



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Digital Pathology

This facility provides a slide scanning system that allows users to digitise entire glass slides at high quality resolution and then review and manage the resulting images locally or remotely using a web-based digital pathology information system. A robust server network supports image management and analysis and allows the secure hosting of the user's digital slides.

Application:

This technology lends itself to many applications from elucidating pathways of disease and understanding patient prognosis to biomarker development and drug discovery. A variety of slides can be scanned including histological or immunohistochemically stained full-face sections, tissue microarrays (TMA) and cell pellet arrays.

Instrumentation:

Aperio ScanScope XT high throughput scanner with 120-slide capacity capable of scanning whole glass slides at 20x or 40x magnification, creating seamless, true-colour digital slide images in minutes.

ImageScope, a free Aperio download for viewing the scanned images that allows viewing of multiple images simultaneously, pan and zoom, comparison of stains and annotates areas of interest.

Spectrum, an online database that hosts and manages the scanned images offering advanced visualisation, digital slide viewing, grading, links to clinical information, data archiving and image analysis. An in-built TMA segmentation tool enables identification and analysis of individual TMA cores.

Analysis toolbox contains a library of algorithms that offers an alternative to manual grading of tissue and TMAs. The algorithms enable automated, objective cell and area quantification of tissue staining based on the stain intensity values.

Expertise & Services:

Providing a range of technical services and expertise including:

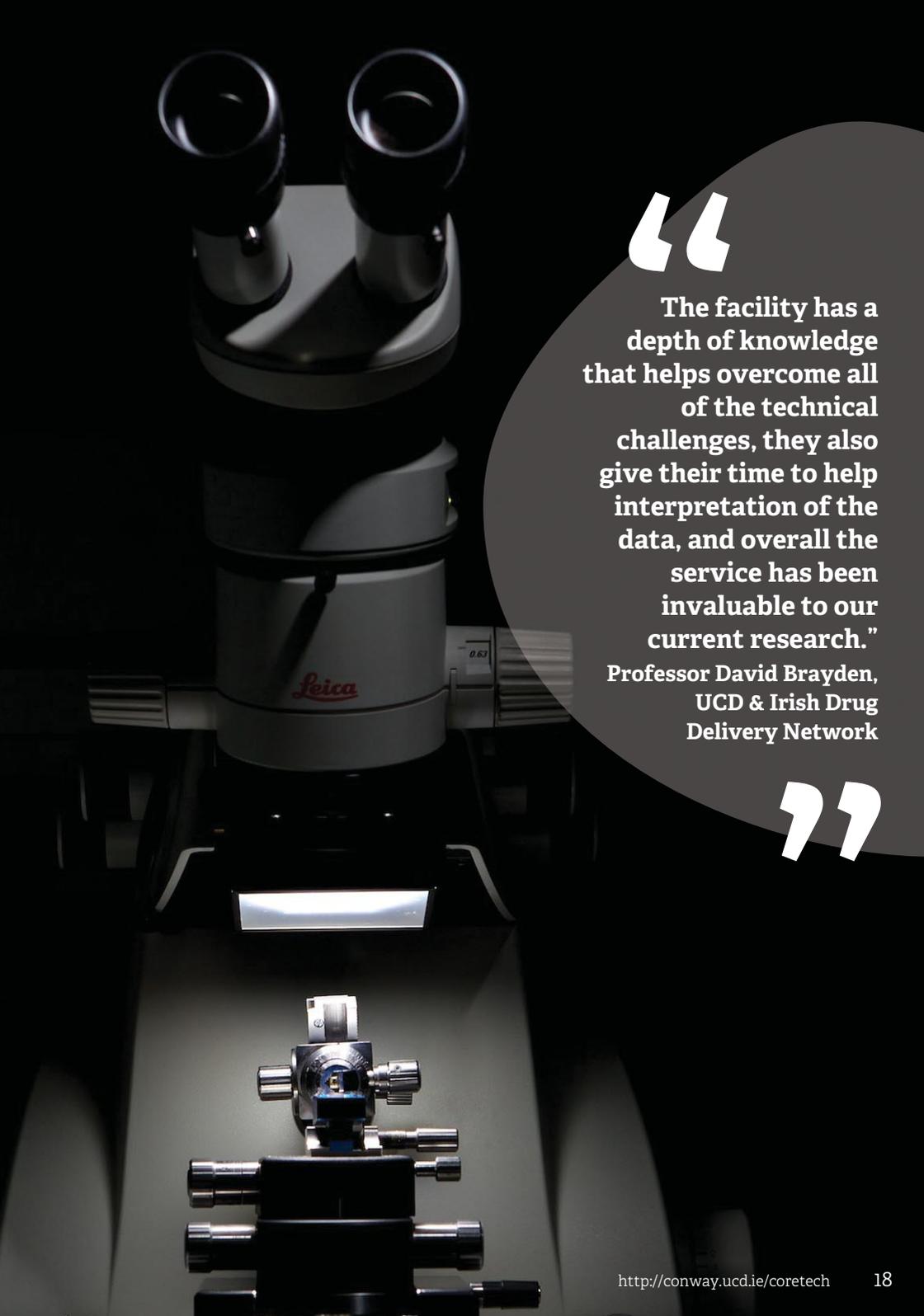
- Advice on project design and specific requirements
- Training courses on slide scanning and digital slide analysis
- Assisted sessions on any aspect of digital pathology
- Slide scanning service
- Image analysis

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“

The facility has a depth of knowledge that helps overcome all of the technical challenges, they also give their time to help interpretation of the data, and overall the service has been invaluable to our current research.”

**Professor David Brayden,
UCD & Irish Drug
Delivery Network**

”

Flow Cytometry



Flow Cytometry Cell Sorting

Multiplexed Assay Platforms

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Director's Introduction

Flow cytometry is an incredibly efficient technique for counting and examining the physical and biological characteristics of cells and particles. The technique has many applications in humans, animals, plants and microorganisms.

We provide a comprehensive service for commercial clients and academic researchers who use the technology across a wide range of studies from obesity and cancer research to nanoparticles and biofuel investigations. We perform beta testing of instruments for companies such as BD Accuri, Beckman Coulter and Chemometech and also provide a consultancy service for companies using this technology.

What really differentiates our service is the expertise of our team in assisting with the analysis of complex results for our clients and research partners. We aim to find a tailored flow cytometry solution that works for their research. It is this expertise that also enhances the quality of our education and training programmes.

Education

Our team are involved in the delivery of both accredited graduate and continuing professional development modules to scientists interested in using flow cytometry techniques within their research.
CNWY40090 Introduction to 'Omics' & Advanced Imaging Technologies
CNWY40130 Flow Cytometry – Principles & Practice

Details: <http://www.ucd.ie/conway/education/>

Flow Cytometry

Flow cytometry technology can be used to measure intrinsic cell characteristics such as size, shape and granularity and extrinsic cell characteristics such as DNA, internal and external receptors. This has many applications in humans, animals, plants and microorganisms with the most common applications in cell cycle, apoptosis/necrosis, ploidy determination, immunophenotyping, protein expression and Ca^{2+} concentration.

Cell sorting allows the physical isolation of cell populations for further procedures such as cell culture and studies of protein expression.

Multiplexing or multiple analyte detection offers a broad picture of the cytokines involved in a certain biological process. The measurement of cytokines and other soluble factors is becoming increasingly important in the study and management of numerous diseases.

Instrumentation:

FLOW CYTOMETRY

- **Beckman Coulter Epics XL-MCL:** This instrument allows simultaneous measure of FSC, SSC and up to 4 colours using a 488nm laser and has an automated sample loader that permits a throughput of 100 samples/hour.
- **Beckman Coulter FC500:** The next generation of the Beckman Coulter Epics XL-MCL is able to analyse up to 5 colours using a 488nm laser and has an automated sample loader.
- **Beckman Coulter CyanTADP:** Two instruments are available, each with three lasers: one with 488nm (blue), 561nm (green) and 635nm (red) and the other one with 405 nm (UV), 488nm (blue) and 635nm (red). This allows us to detect up to 11 parameters at the same time and offers complete compensation and analysis rates of up to 50,000 events/second.
- **BD Accuri C6:** Flow Cytometer® System has a high specification with 2 lasers, 2 scatter and 4 fluorescence detectors. Designed to work well with current protocols and reagents, the C6 is a high performance flow cytometer, simplified. Extremely easy to use, it is an ideal tool for less experienced users. It is portable and can be easily moved to other laboratories.

CELL SORTING:

- **FACSAria III Cell Sorter:** This high-speed cell sorter (40,000 events/second) has 4 lasers: 488nm (blue), 561nm (green), 633nm (red) and 407nm (violet) for detection of FSC, SSC and up to 10 fluorescent parameters. It is able to sort 4 populations of cells at the same time and perform single cell cloning in well plate platforms with a 100% purity level and 95% viability.

MULTIPLEXING:

- **Luminex xMAP200:** The bead-based assays follow the same principle as a sandwich immunoassay. Fluorescent beads are coated with antigen-specific antibodies. A mixture of coated beads is incubated with the sample. Analytes in the sample bind to the Ab coating the beads. A biotin-conjugated Ab mix is added, which binds to the analytes bound to the capture Ab. A fluorochrome binds the biotin conjugates. One of our instruments differentiates the bead populations and calculates the analyte concentration in the samples being analysed
- **Randox Evidence Investigator:** This offers complete patient profiling with the most comprehensive test menu on the market. It consolidates immunoassay and molecular diagnostics on a single platform with protein and DNA biochips. Utilising the revolutionary Biochip Array Technology, it allows simultaneous detection of multiple analytes from a single sample for efficient and cost effective testing. Signal reagent is added to each biochip before imaging. A CCD camera images each biochip carrier in less than two minutes. The light signal generated from each of the discrete test regions on the biochip is simultaneously detected. The analyser uses unique image processing software to translate the light signal generated from the chemiluminescent reactions into an analyte concentration.

Providing a rapid, reliable, cost-effective and informative solution, the main benefits of multiple analyte detection are:

- Reduced cost and labour by multiplexing
- Requires less than 50 μ l of sample
- Shortened time-to-results by favourable reaction kinetics
- Give faster, more reproducible results than ELISA
- Flexible multiplexing in the range of 1 to 100 analytes meets the needs of a wide variety of applications such as protein expression profiling, focused gene expression profiling, autoimmune disease, genetic disease, molecular infectious disease, and HLA testing

Expertise & Services:

- The flow cytometry facility provides a range of services including instrumentation, workstations, training, software for analyses as well as technical expertise and advice.
- Trained users prepare and run their own samples.
- Untrained users may avail of the sample running service and results analyses.



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Associated Technologies

There are a number of associated technologies, located either within UCD Conway Institute or on the wider campus, that are under the management of Conway Fellows. These technologies have been secured through competitive funding applications and are available for use through a collaborative arrangement.

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Protein Expression Factory

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www.ucd.ie/conway

<http://conway.ucd.ie/coretech>

Investing in Your Future



Ireland's EU Structural Funds
Programmes 2007 - 2013

Co-funded by the Irish Government
and the European Union



EUROPEAN REGIONAL
DEVELOPMENT FUND



An Roinn Post, Fiontar agus Nuálachta
Department of Jobs, Enterprise and Innovation

HEA

Higher Education Authority
An tÚdarás um Ard-Oideachas