



**PHILIPS**

IntelliSpace

Discovery 3

# Philips IntelliSpace Discovery 3

**End-to-end AI solution for medical research**

IntelliSpace Discovery is for research use only and cannot be used for patient diagnosis or treatment selection.

# Philips IntelliSpace Discovery 3

## Your upgrade to artificial intelligence in medical research

Philips IntelliSpace Discovery is an integrated AI solution that enables the entire process of generating new AI applications, providing data integration, training and deployment in the research setting.

The IntelliSpace Discovery Research Suites include tools to create tailored data analysis and AI solutions in a clinical environment.

### How can you benefit from IntelliSpace Discovery?

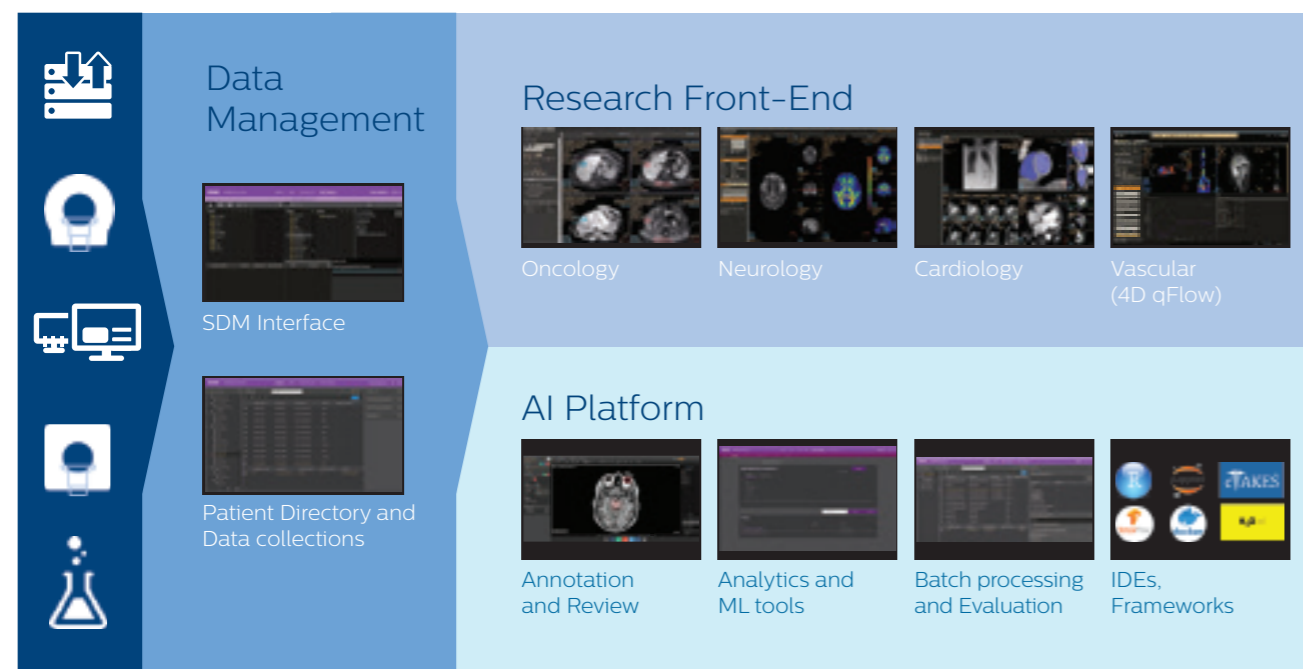
IntelliSpace Discovery offers an open and programmable **solution for AI** combined with **advanced visualization** and **data management**.

- Gain ubiquitous access** to all research applications and data: access the zero-footprint client-server architecture from any client in your network via standard web-browsers
- Drive clinical research:** The easy-to-use research suites for physicians and technicians provide access to state-of-the-art analysis and AI methods
- Enable targeted development** of AI methods: The integrated development and analytics environments allow direct data access and real-time feedback between physicians and data scientists to enhance collaboration
- Evaluate new AI tools efficiently:** Process complete test datasets using the AI runtime environment, embedded in the batch-processing architecture
- Leverage your existing work:** Link to standard research tools such as Python and integrate your own results – versatile programming interfaces provide seamless integration with IntelliSpace Discovery

- Gain full control** over all research data and results: The study data management solution interfaces a vendor neutral research archive (VNRA) integrating all relevant data, documents and results
- Benefit from Philips' scientific expertise:** Need help developing your solution? Tackle common challenges together with Philips experts to enable you get the most out of IntelliSpace Discovery. We are on hand to help in the following areas: interfacing and integration of tools, data ingestion, model creation and training
- Future-proof your solution:** In the rapidly evolving AI technology environment, Philips RightFIT service agreements deliver upgrades and updates to your solution, providing access to next-generation research suites, cutting-edge deep learning frameworks and all future platform enhancements
- Participate in a full ecosystem** of solutions: Discovery Store offers a rich set of readily available tools and AI solutions for research. Use this platform to share your algorithms and tools with the ISD research community

### IntelliSpace Discovery solution consists of:

- An **advanced visualization (AV)** solution for use by physicians and technicians, which provides access to AI tools and advanced data processing and review capabilities
- An interface to a **development environment** built on state-of-the-art IDEs and AI frameworks for the creation of new analytic models for use by data scientists and software developers
- A **runtime environment** for ease of deployment in any research environment
- A **data management** solution (DMS) that supports aggregation, curation and annotation of data relevant for developing specific AI assets
- Philips Research Services** to tailor the solution to your individual needs
- IntelliSpace Discovery Store** to access latest research applications and plugins. The store also supports sharing your algorithms and plugins with the community



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# IntelliSpace Discovery – one solution for AI

## Research front-end applications

A number of Research Suites offer dedicated functionality for the analysis of data from different modalities and clinical applications. Furthermore, the core package provides a patient directory for data management, auto- and batch-processing capabilities, APIs to interface your own tools and standard research software, as well as a multi-modality image viewer.

### IntelliSpace Discovery solution is built on four pillars:

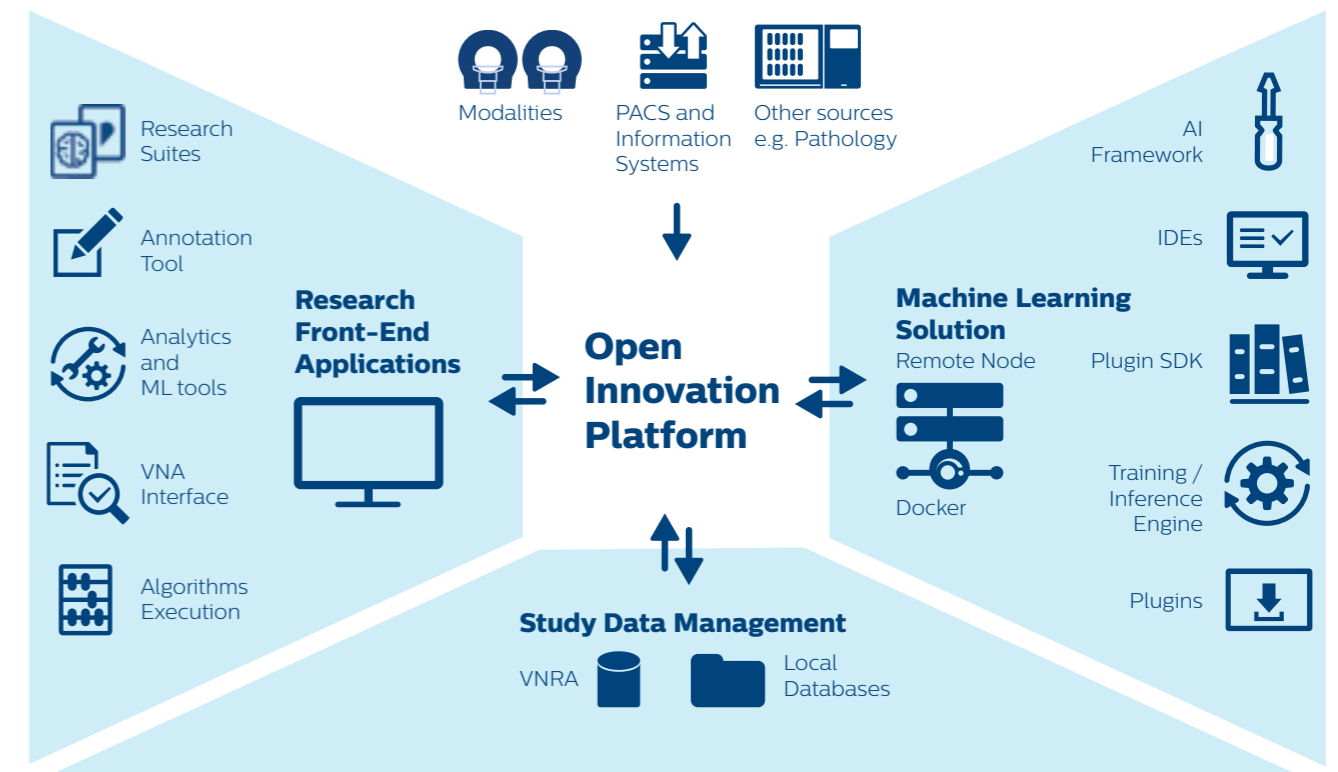
1. Research front-end applications
2. Study data management interfacing to VNRA
3. Machine learning solution
4. Philips Research Services

## Study data management

IntelliSpace Discovery provides a full-featured Study Data Management Solution, which lets you integrate DICOM studies with clinical information, patient treatments, disease states, comorbidities, and more. The data is hierarchically structured according to projects, subjects and experiments. And user rights management helps you deliver the right information to the different user roles in your clinical study.

The Study Data Management Solution interfaces with a vendor neutral research archive (VNRA) and is based on opensource software. It facilitates common management and handling of imaging and non-imaging data. Consuming data from multiple sources, it maintains it in a centralized repository to distribute to approved users. In addition to a built-in web interface, access and management of the VNRA is provided by an application directly embedded in IntelliSpace Discovery.

## IntelliSpace Discovery at a glance



## Machine learning solution

Clinicians and hospital administrators have never had access to more data and at the same time, it has never been harder for them to process it: Too much data and too little time.

AI can generate value across the health continuum, with its ability to help translate large amounts of data into actionable insights.

At Philips, we have recognized this potential and have responded with an AI platform for healthcare research that supports both data scientists and physicians.

IntelliSpace Discovery provides a comprehensive set of solutions for data aggregation, curation, integration and annotation, as well as deep learning network training and deployment for evaluation and analysis of new live data.

The Annotation Suite supports annotation of images using labels, key-value pairs, quality rating and many more user-defined parameters for complete study data. This helps you efficiently review large datasets, both for ground-truth generation and review of AI results on test datasets.

For data scientists, IntelliSpace Discovery interfaces a collaborative development environment designed to support an end-to-end workflow for creating AI assets.

With these analytics and machine learning tools, you can create projects and start editing your code in your preferred IDEs. To this end, you can utilize tools such as R-Studio and Jupyter Notebook. Common deep learning frameworks such as TensorFlow and H2O can be used in the scalable Docker environment. Moreover, you can easily extend the open platform with further frameworks, including PyTorch and other Python libraries, to further improve your efficiency.

IntelliSpace Discovery also provides a Machine Learning Software Development Kit (SDK), which delivers methods for accessing data for preparation and pre-processing, analysis measures, and ways to control and evaluate outcome and performance.

# Research suites



## Research **Oncology Suite**

The Research Oncology Suite implements dedicated functionality for longitudinal follow-up. In addition to side-by-side visualization of multiple DICOM studies, the solution supports detailed inspection of individual studies with versatile viewing layouts. ROS provides multiple semi-automatic volumetric segmentation tools for rapid delineation of target volumes. It supports calculation of a range of statistical features of segmented volumes, including lesion volume and the diameters required by RECIST criteria, such as maximum diameter and orthogonal diameter. The lesions, i.e. tumors and lymph nodes, can be labelled to automatically determine RECIST response criteria. Moreover, functional parameters can be extracted, including from parametric maps, for alternative response assessment. The ROS features the Algorithm Plugin Interface to integrate plugins for parametric mapping, registration, segmentation, feature extraction and more.

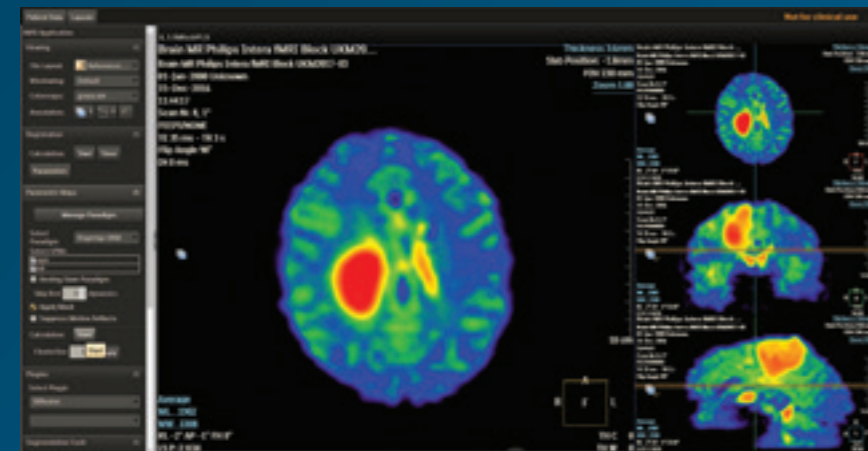


## Research **Cardiology Suite**

The Research Cardiology Suite supports visualization and analysis of multimodal and multiparametric cardiac images. It allows cardiac reorientation (SA, HLA, VLA) for CTA, simultaneous viewing of cardiac data from MRI, CT, CR and movie view of dynamic data, e.g. interventional X-ray or U/S. Of course, the Research Cardiology Suite also features the Algorithm Plugin Interface to run additional plugins, for example automatic cardiac segmentation of up to 17 anatomical structures.



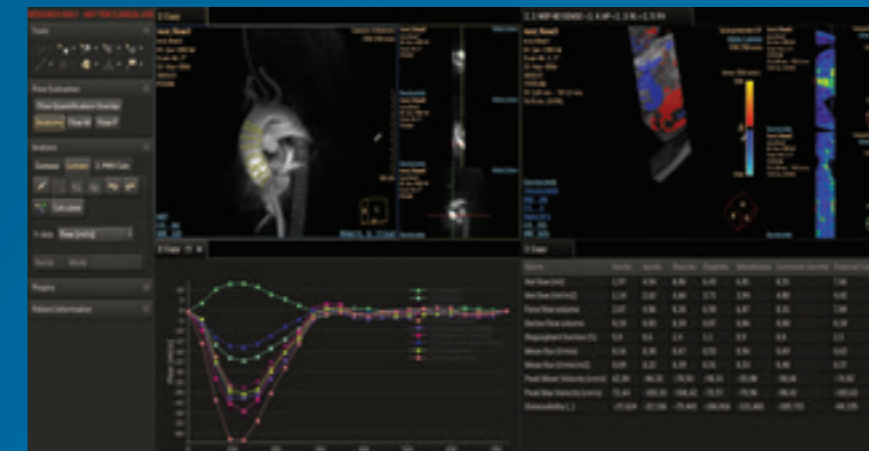
## Research **Neurology Suite**



The Research Neurology Suite provides advanced visualization and analysis of brain image data with a particular focus on functional MRI. It comes with four main packages: fMRI analysis, DTI analysis, general imaging analysis tools and the Algorithm Plugin Framework. Additionally, the suite offers interfaces to opensource packages such as AFNI, SPM and FreeSurfer developed by neuroscience communities.



## Research **Vascular Suite**



The IntelliSpace Discovery Research Vascular Suite (RVS) offers a solution for reviewing and analyzing 4D phase-contrast MRI data for flow quantification in arbitrary planes and anatomies. The RVS provides the functionality to analyze both planar and volumetric flow datasets. It allows the visualization of the velocity field as measured by MR on top of the anatomical images with color maps representing the flow. Furthermore, it provides graphical and table representations of various flow parameters.



## Plugins

A series of powerful plugins is available to enhance the functionality of the research suites:

**Radiomics** – for the feature calculations to be executed on large datasets in unattended mode by the widely used PyRadiomics package. PyRadiomics supports the extraction of more than 1400 features including first-order statistics, texture features and surface features.

**Spectral CT / IQon SBI analysis** – tools for the selective creation of individual derived series and maps from SBI data, including manual input of additional parameters such as keV values for MonoE series and a viewer with on-the-fly selection of derived series/maps.

**Model Based Segmentation Framework** – for the adaptation of a generic organ model to images of a specific patient. Supported organs include heart, liver and deep brain structures.

**Parametric maps** – calculation of semi-quantitative parametric maps derived from dynamic contrast enhanced studies including area-under-curve, time-to-peak, max slope, wash-in, wash-out, mean transit time, area-under-curve TTP, final slope, plus additional features that describe dynamic imaging.

**Standard image processing** – tools for registration, segmentation, filtering, etc...



Spectral CT / IQon SBI analysis

## Versatile programming interfaces

IntelliSpace Discovery supports the development of **new workflows** and lets you combine **advanced built-in functionality** with established research tools like Matlab® and Python. Multiple programming interfaces support the **integration of your own software tools**. IntelliSpace Discovery provides the Algorithm Plugin Framework (APF) that allows integration of third-party libraries and own algorithms developed in C, C++, C#, Matlab and Python as plugins into the Research Suites. In addition, APIs to integrate script languages like Python and Matlab as well as compiled executables are also available. Plugins and interface algorithms can run as auto- and batch-processing steps to efficiently analyze large datasets.

### Auto-processing and batch-processing

Auto-processing and batch-processing capabilities run in the background for computationally heavy tasks.

### Patient directory

The patient directory allows access to imaging data received from your PACS or IntelliSpace Portal and helps you manage your workflows.

### Multi-modality image viewer

This viewer supports a range of rendering options, fusion of two volume datasets, and a variety of measurements. You can also use it to visualize results from other tools and applications in IntelliSpace Discovery.



Integration of your own plugins

## IntelliSpace Discovery configuration and additional data

### System configuration

The IntelliSpace Discovery server and client computers are located within your firewall, allowing your research data remains under your full control. DICOM connectivity enables data to be sent directly from PACs, modalities and IntelliSpace Portal. Client PCs are zero-footprint with access to the IntelliSpace Discovery GUI from a standard web-browser (Chrome recommended). Proprietary technology streams display content to the client over a LAN, WAN or any broadband Internet connection through the customer's VPN (virtual private network) without the need to download imaging data to the client PC. This means memory and CPU intensive operations including 3D rendering take place on the server, thus minimizing requirements of the client PC.

The client-server architecture enables multi-user access and up to 5 instances of each application can be run concurrently. The number of concurrent users accessing the Patient Directory is unlimited.

### Server hardware option

**IntelliSpace Discovery is available with Tower or Rack server hardware provided by Philips that is suitable for use in most research environments and has the following specifications:**

- CPU: 2x Intel Xeon E5-2643v3 @ 3.4 GHz
- RAM: 32GB
- Disks: 3x 1.2TB in Raid (net 2.1TB)
- Windows server 2016 OS standard edition (license included)
- Philips IntelliSpace Discovery server software

### Network connectivity recommendations are as follows:

- Gigabit connections recommended
- Domain based network environment recommended
- Network bandwidth/latency for home connections: 5 Mbit/s or above download speed, 512Kbit/s or above upload speed with latency <20ms

### Virtual machine option

For those who prefer virtual environments, IntelliSpace Discovery is also available as a software only option installed on a customer owned Virtual Machine. In this case the customer is responsible for meeting the minimum requirements and maintaining the virtual environment.

### Recommended Virtual Machine Specifications are as follows:

- CPU: 12 Cores @ minimum 2.9 GHz; distributed across 4 sockets or less; preferably 2 sockets each with 6 cores
- RAM: 32GB; reserved, not over-committed
- Network interface card: 1 Gbps or more
- Storage space: 0.5 – 5 TB according to needs
- Storage access speeds: 2000 IOPS available at all times
- Windows server 2016 OS standard edition (license provided by customer)

## IntelliSpace Discovery store

The IntelliSpace Discovery store is a cloud-based solution provided by Philips, which contains a library of the latest research applications and plugins for easy download and installation on your local IntelliSpace Discovery server.

The IntelliSpace Discovery Store also provides the opportunity for you to make your own algorithms and plugins available to other users in the IntelliSpace Discovery community.



## At your **service**

We know your time is precious – and we are committed to helping you use it as efficiently as possible. That is why our team of experienced technical experts delivers additional research support. Philips Research Services offers you a direct link to the Philips Research Organization with access to the latest software tools for quantification, image registration, segmentation and analytics.

**Philips Research Services** help you create tailored workflows, customize your research infrastructure and support your research in the following areas:

**This support is tailored to your individual requirements including the following areas:**

- Development of dedicated features and research algorithms
- Interfacing to existing research infrastructure and tools
- AI algorithm training
- Data analysis and data management
- Customized plugin implementation and wrapper creation

*This optional service is provided on an hourly basis.*

