Deepcell

Introducing REM–I

A benchtop single–cell imaging and sorting instrument
for high–dimensional morphology analysis

Highlights

- Obtain high–dimensional single–cell morphology analysis with the REM–I instrument

- A fast workflow to go from sample to publishable figure in a few hours

- Part of the REM–I platform, which also includes Deepcell's Human Foundation Model (HFM) and Axon data suite

Cell morphology can be highly indicative of a cell's phenotype and function, but it is also highly dynamic and complex, and analyzing morphology by eye can only tell us so much.

A more quantitative, high–dimensional, unbiased approach to assessing cell morphology would magnify the insights into a cell's phenotype and function. Methodologies to assess and characterize cell morphology have been limited to either imaging or sorting with labels—until now.
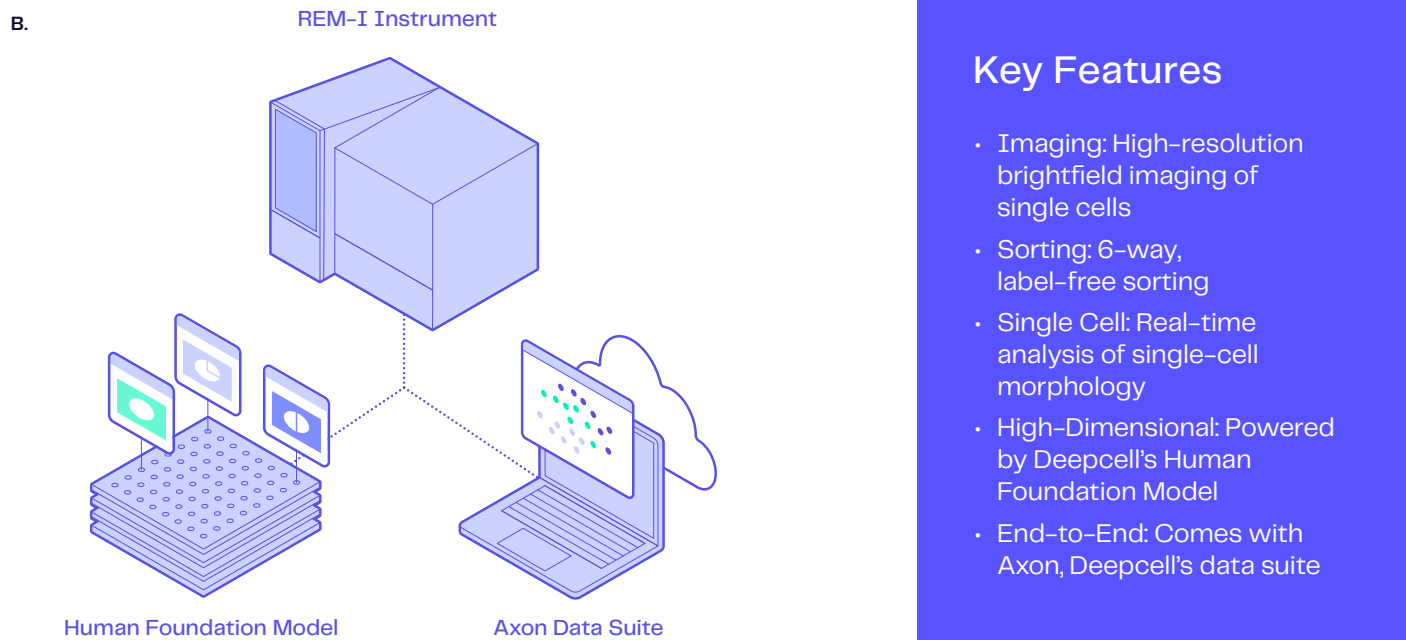
Deepcell's REM–I instrument takes the best of these worlds and builds upon them to provide imaging of single cells and label–free sorting in one platform (Figure 1A). REM–I directly takes real, high–resolution brightfield images of each individual cell. REM–I also has the ability to sort cells 6 ways based on their morphology without the need for any labels. Furthermore, you can collect these viable, minimally perturbed cells for downstream analysis such as single–cell RNA sequencing (scRNAseq).
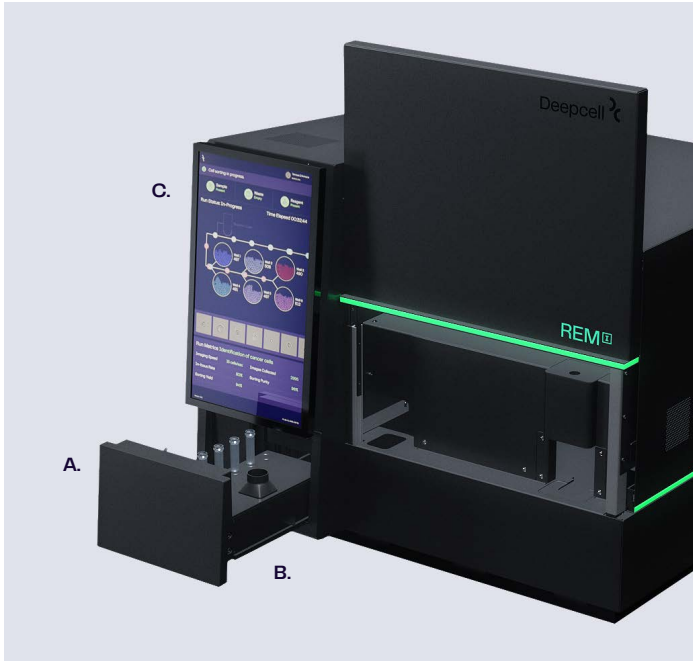
The REM–I instrument is part of the REM–I platform, which also consists of Deepcell's Human Foundation Model (HFM) for high–dimensional morphological feature analysis and Axon data suite, where you can store, visualize, and analyze images and high–dimensional data (Figure 1B).
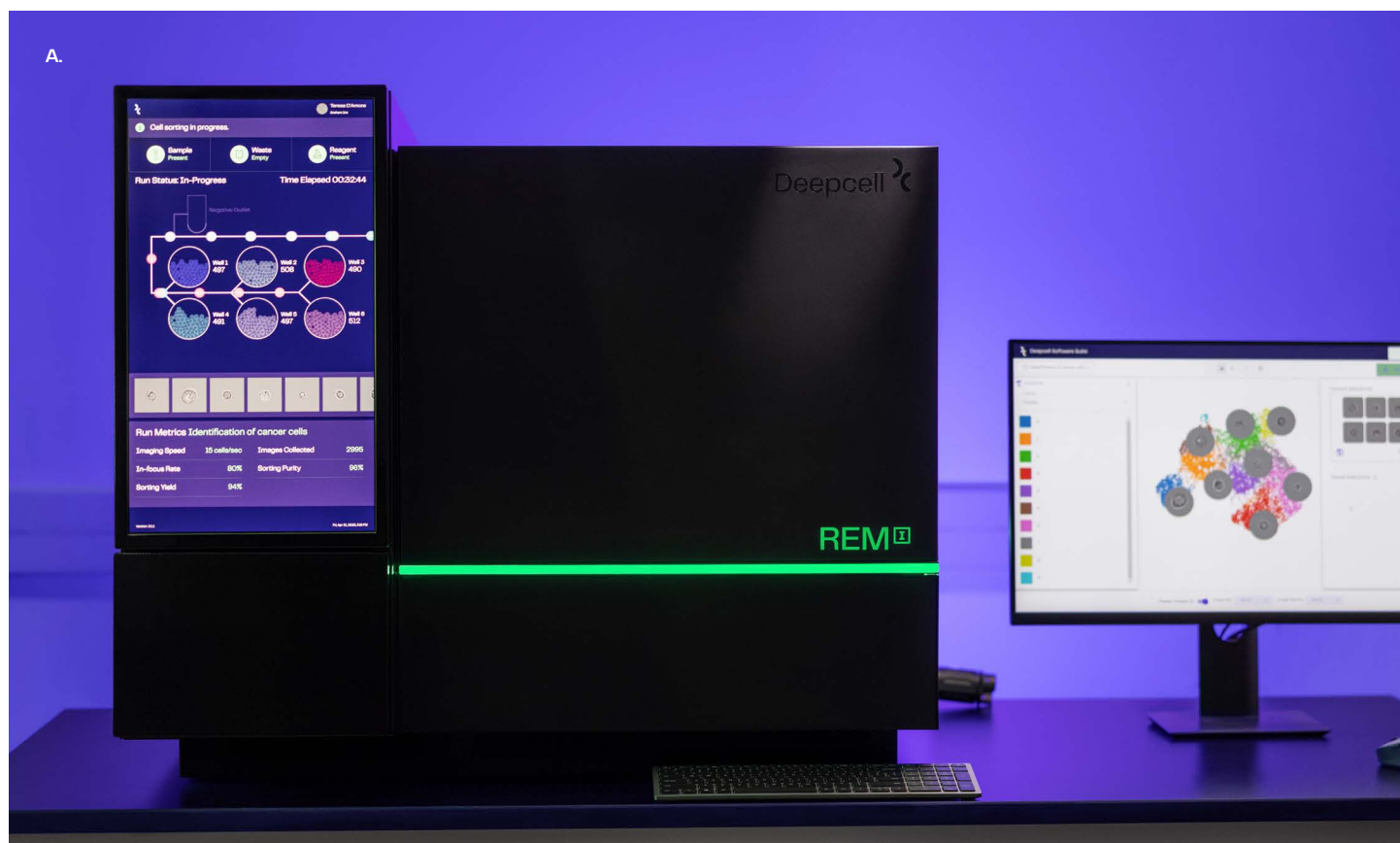
Figure 1. The REM-I platform. (A) The REM-I instrument is a benchtop microfluidics instrument that captures high-resolution brightfield images of single cells and can sort cells 6 ways in a label-free manner. (B) The REM-I instrument is part of a fully integrated platform, compatible with Deepcell's Human Foundation Model (HFM) and Axon data suite.

B.

REM–I Instrument

Human Foundation Model   **Axon Data Suite**

Key Features

- Imaging: High–resolution brightfield imaging of single cells
- Sorting: 6–way, label–free sorting
- Single Cell: Real–time analysis of single–cell morphology
- High–Dimensional: Powered by Deepcell's Human Foundation Model
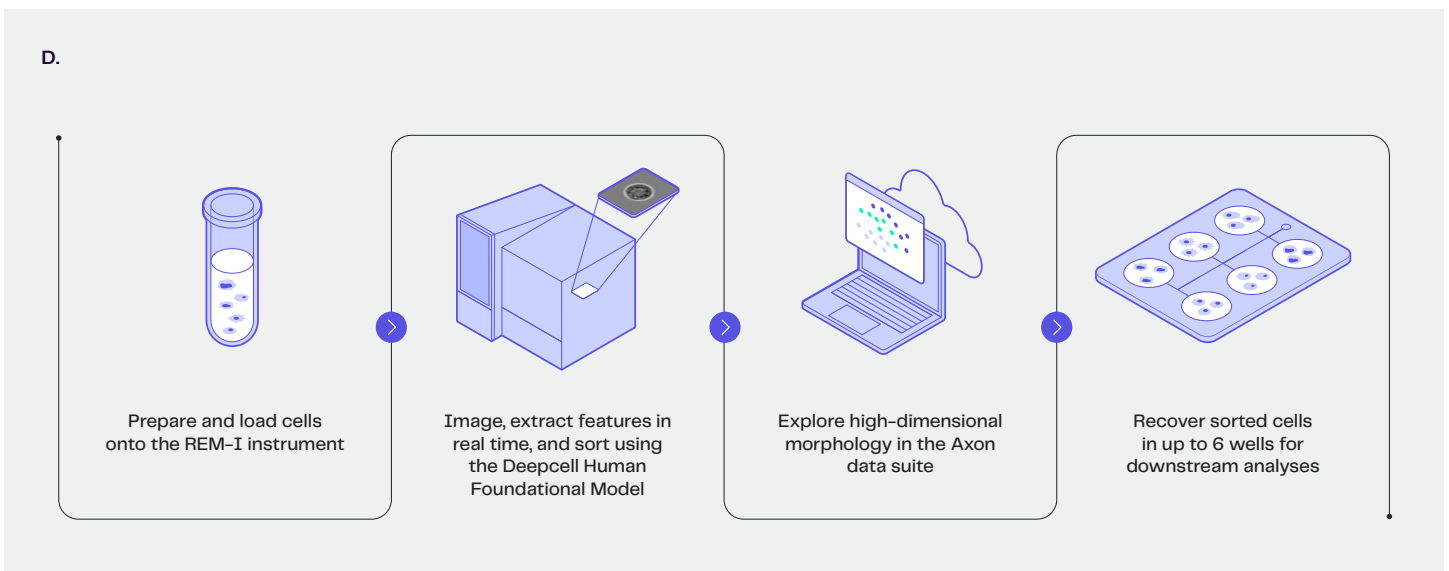- End–to–End: Comes with Axon, Deepcell's data suite

Figure 2. How the REM-I instrument works. The REM-I instrument uses a set of reagents and chips provided by Deepcell. Reagents are placed in the reagent drawer (A) and chips are loaded onto the stage. (B) The REM-I instrument is controlled by the REM-I controller software while the REM-I on-instrument display (C) shows real-time run status. (D) The workflow is simple and streamlined, starting with dissociation of cells into a single-cell suspension, followed by loading of the suspension onto the instrument. The cells are imaged and characterized in real-time with the Deepcell HFM as they flow through the microfluidic chip. Axon, Deepcell's data suite, pairs with the REM-I instrument for in-depth data analysis, including the ability to select cell populations of interest to sort on the REM-I instrument. Sorted cells can be used for further downstream analyses such as scRNAseq.

How it works

The REM–I instrument uses high–throughput imaging to characterize, classify, and sort cells based on morphological analyses (Figure 2).

The benchtop instrument uses a microfluidic chip, which allows for the input and flow of cells in suspension. The high–speed system collects brightfield images of cells (up to 1,000 events per second) as they flow through a microfluidic chip. High–resolution images capture subcellular and subnuclear features of the cells in high contrast. The HFM classifies cells, allowing them to be sorted in up to 6 collection wells. A laser–based system tracks cells in real–time to assist with imaging and sorting, and to report on the purity and yield of the run.

The REM–I workflow is simple and streamlined, starting with preparation of a single–cell suspension, followed by loading of the cells onto the instrument. The cells are imaged and features are extracted in real–time and sorted using the HFM. Axon, Deepcell's data suite, pairs with the REM–I instrument for in–depth data analysis, including the ability to select cell populations of interest to sort on the REM–I instrument. Sorted cells can be recovered in up to 6 wells and used for further downstream analyses such as scRNAseq.

D.

Prepare and load cells onto the REM–I instrument

Image, extract features in real time, and sort using the Deepcell Human Foundational Model

Explore high–dimensional morphology in the Axon data suite

Recover sorted cells in up to 6 wells for downstream analyses

Key research areas

- Cancer Research
- Developmental Biology
- Cell & Gene Therapy
- Drug & Functional Screening

Applications

- Discovery
  — Morphology as a novel biomarker
  — Drug and CRISPR perturbation screening
- Sample–Level Profiling
  — Heterogeneous sample evaluation and characterization
  — Disease detection and enrichment
  — Sample clean up
- Cell–Level Phenotyping
  — Cell health status
  — Cell state characterization
  — Multi–omic integration

Table 1. *REM-I Instrument Key Parameters and Specifications*
*Denotes specification is dependent on sample characteristics and/or sorting configurations

Category	Parameter	Specification
Facilities	Instrument dimensions	H: 29.5 in / 75 cm W: 35.5 in / 90 cm D: 29.5 in / 75 cm
	Included ancillary equipment	Computer tower Monitor Keyboard Mouse
	Electrical	3x 100–240 V surge–protected outlets
	Network connection	1 Gbps ethernet with >150 Mbps upload bandwidth
	Clean dry air connection	0.55–0.72 MPa / 80–105 psi
	Temperature operation ranges	59–86 °F / 15–30 °C
	Operating relative humidity (%)	15–70, non-condensing
Instrument	Input cell size (μm)	6 – 25
	Output cell viability (% of input viability)	≥95*
	Output collection	6x positive outlet wells 1x negative outlet tube 1x waste bottle

Table 1. *(Continued from previous page)*

Instrument	Positive outlet capacity (cells/well)	Up to 3,000
	Recommended run time (min)	Live cells: Up to 180
		Fixed cells: Up to 600
	Image resolution (pixels/μm)	6.3
	Image size (pixels)	256 x 256
	Imaging throughput (events/s)	Up to 1,000
	Sorting throughput (cells/s)	Up to 30

Table 2. *REM-I Platform Components*

Name	Description
REM–I Instrument	Microfluidic instrument
REM–I Imaging Kit	Reagents and consumables for imaging workflow
REM–I Sorting Kit	Reagents and consumables for imaging plus sorting workflow
Human Foundation Model (HFM)	Deepcell's AI model for high–dimensional single–cell morphology analysis
Axon data suite	Deepcell's data suite for visualizing, analyzing, and storing data

References

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2. Mavropoulos A. et al. Artificial intelligence–driven morphology–based enrichment of malignant cells from body fluid. Mod Pathol, 2023. DOI: 10.1016/j.modpat.2023.100195.

3. Masaeli M. et al. Multiparameter mechanical and morphometric screening of cells, Scientific Reports, 2016. DOI: 10.1038/srep37863.

4. Bagheri N. et al. The new era of quantitative cell imaging–challenges and opportunities. Mol. Cell, 2022. DOI: 10.1016/j.molcel.2021.12.024.

5. Way G. P. et al. Predicting cell health phenotypes using image–based morphology profiling. Mol. Biol. Cell, 2021. DOI: 10.1091/mbc.E20–12–0784.

6. Walter T. et al. Visualization of image data from cells to organisms. Nat. Methods, 2010. DOI: 10.1038/nmeth.1431.

Resources

→ REM–I Platform Brochure

→ Human Foundation Model Panel Sheet

→ Public Datasets and Axon Demo

→ Oncology Application Note

→ Other Resources

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