ORBITS - ORGANOID IMAGE & DATA ANALYSIS PLATFORM

Orbits 2.0: A Platform-Agnostic Foundation Model for Automated and Reproducible Label-Free Organoid Image Analysis

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DrugVision.AI



Capture on Your System

Capture brightfield or fluorescence images over time on your existing imaging system.



Upload & Organize

Manage screening experiments across user accounts, with structured images, plate layouts, treatments, timepoints, channels, and replicate metadata.



Segment & Classify

Detect organoids, classify morphologies, and track across the full time course.



Quantify Phenotypic Drug Response

Generate decision-ready metrics from growth, death, morphology, and treatment kinetics.



Export & Integrate

Export analysis-ready results, QC summaries, and structured reports for downstream interpretation.

BACKGROUND & AIM

Live-cell imaging for tumor organoid drug screening

Patient-derived tumor organoids are increasingly used in cancer drug discovery and precision medicine because they preserve clinically relevant tumor features while enabling functional therapy testing.

Automated live-cell imaging provides richer information than endpoint ATP-based viability assays by capturing organoid growth kinetics, morphological changes, and temporal drug-response patterns. Importantly, longitudinal imaging can help distinguish cytostatic responses from cytotoxic effects at single organoid level.

However, live-cell imaging workflows remain difficult to standardize, limiting reproducibility and broader adoption.

Challenges

- Protocol diversity and platform-specific acquisition settings complicate cross-study comparison
- Vendor- or assay-specific software limits reproducible analysis across imaging systems
- Fluorescent readouts add variability, assay complexity and phototoxicity risk

A standardized, microscope-agnostic, label-free analysis framework is needed to make live-cell organoid durg screening reproducible and scalable.

MATERIALS & METHODS

- Drug screening was performed using an automated 384-well widefield live-cell imaging workflow at the **DrugVision.AI robotic screening platform[1].**
- Orbits 2.0 was developed as a **centralized web platform** for standardized organoid image segmentation and classification.
- **A foundation model** was trained on diverse organoid images across morphologies, imaging systems and assay conditions.
- **Model-version reproducibility** was assessed by comparing Orbits 2.0 with Orbits 1.0 using the viability metric[2].
- **Cross-platform reproducibility** was assessed using matched Tecan Spark Cyto and ZEISS CellDiscoverer 7 drug screens.
- **Brightfield-based cytostatic/cytotoxic classification** was assessed using NOGR[3].

NOGR drug-response metric

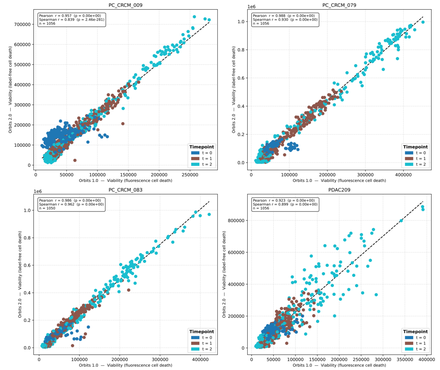
Viability **(V)** was calculated as the total viable organoid area per well:

Orbits 1.0: V = organoid area − green fluorescent cell-death area, excluding label-free classified dead organoids
Orbits 2.0: V = organoid area − label-free cell-death area

From **V**, organoid growth rate was calculated and normalized to vehicle and positive controls to obtain **NOGR[3]**.

RESULTS

Model-version reproducibility



- **Strong correlation** between Orbits 1.0 and Orbits 2.0 viability measurements.
- Orbits 2.0 enables **fully label-free viability quantification** while Orbits 1.0 requires a fluorescent cell death marker.
- Orbits 2.0 **improved detection of small T0 organoids** in selected models, including PC_CRCM_009, a know limitation of Orbits 1.0.

Figure 1. Model-version reproducibility.
Well-level viability values from Orbits 1.0 and Orbits 2.0 showed strong correlation across organoid models and timepoints. Orbits 2.0 reproduces Orbits 1.0 viability outputs while using a fully label-free workflow instead of a fluorescent cell death marker.

RESULTS

Cross-platform reproducibility

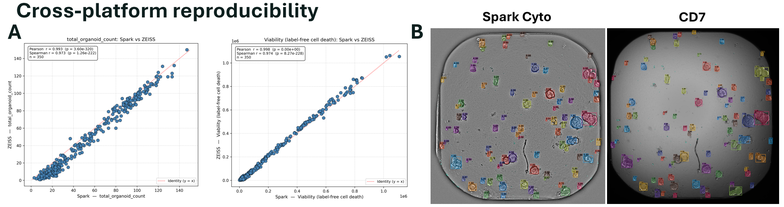


Figure 2. Cross-platform reproducibility of Orbits 2.0 analysis.
Matched organoid cultures were imaged on the Tecan Spark Cyto and ZEISS CellDiscoverer 7 platforms and analysed using the same Orbits 2.0 workflow. **(A)** Scatter plots show strong agreement between platforms for total organoid count and label-free viability, with each point representing one matched well. **(B)** Representative brightfield images with Orbits 2.0 overlays illustrate successful segmentation across different image appearances and acquisition systems. Multicolour masks indicate individual organoids and green/cyan masks indicate label-free cell-death areas. These data demonstrate that Orbits 2.0 enables reproducible, microscope-agnostic organoid quantification.

- **Organoid count** and label-free **viability** were **highly correlated across platforms**.
- Orbits 2.0 enables **microscope-agnostic segmentation** despite differences in image appearance.

RESULTS

Label-free cytostatic vs cytotoxic quantification using NOGR

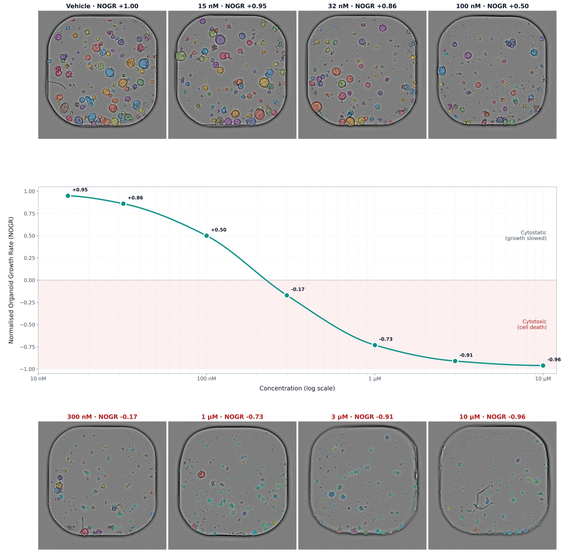


Figure 3. Label-free cytostatic/cytotoxic response classification.
Orbits 2.0 detects organoids and cell-death areas directly from brightfield images. Multicolour masks indicate individual organoids, while green/cyan masks indicate label-free cell-death areas. Dose-dependent NOGR values quantify drug response and distinguish cytostatic growth inhibition from cytotoxic organoid loss. NOGR > 1 indicates increased proliferation, NOGR = 1 vehicle-like growth, NOGR = 0 complete growth inhibition, and NOGR = −1 complete killing comparable to the positive control.

CONCLUSION & FUTURE PERSPECTIVES

Orbits 2.0 enables reproducible, label-free organoid image analysis across models, microscopes and assay conditions.

By combining a centralized web platform with a foundation segmentation model, Orbits 2.0 reduces dependence on local software, microscope-specific workflows and fluorescent viability markers. This supports standardized, scalable and fully label-free quantification of organoid drug responses — including cytostatic versus cytotoxic effects.

Future development will expand the foundation model across additional microscope vendors, imaging settings and culture formats, including organoids grown in extracellular matrix domes, microwell plates and other 3D assay systems. This continued expansion will further generalize Orbits 2.0 and support broad access to reproducible organoid image analysis across research and drug discovery workflows.

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References:

1. Le Compte M, et al. **Multiparametric Tumor Organoid Drug Screening Using Widefield Live-Cell Imaging for Bulk and Single-Organoid Analysis.** J Vis Exp. 2022 Dec 23;(190).
2. Deben C, et al. **OrBITS: label-free and time-lapse monitoring of patient derived organoids for advanced drug screening.** Cell Oncol (Dordr). 2023 Apr;46(2):299-314.
3. Deben C, et al. **Development and validation of the Normalized Organoid Growth Rate (NOGR) metric in brightfield imaging-based assays.** Commun Biol. 2024 Dec 3;7(1):1612.