Artificial Intelligence Interest Group

https://oir.nih.gov/sigs/artificial-intelligence-interest-group

https://list.nih.gov/cgi-bin/wa.exe?A0=ARTIFICIAL-INTELLIGENCE

(Weekly email with upcoming AI-related events)

AI Club

- Seminars, workshops, and journal clubs
- Broad range of topics – AI approaches in biomedical sciences
- For both experts and non-experts
- Mondays, 11AM-12PM
- Building 10, NIH Library Training Room (and virtual)
- Always looking for volunteers!
  - email oneillrs@nih.gov

Current Schedule:

Sept 15 – *Samar Samarjeet (NHLBI)* – "Parallel ML Model Training, Part 1"

Sept 22 – *Samar Samarjeet (NHLBI)* – "Parallel ML Model Training, Part 2"

Sept 29 – *Samar Samarjeet (NHLBI)* – "Parallel ML Model Training, Part 3"

Oct 6 – *Samar Samarjeet (NHLBI)* – "Parallel ML Model Training, Part 4"

Oct 20 – *Emma Campagnolo (NCI)* – "AI-Driven Spatial Transcriptomics Unlocks Biomarker Discovery from Histopathology"

Nov 3 – *Di Huang (NLM/NCBI)* – "Investigating the Impact of Silencers on Disease Using Deep Learning"

Nov 10 – *Sepideh Mazrouee (OD)* – "Replicability in Biomedicine: Challenges, Causes, and Corrections"

Nov 17 – Eric Moyer (NLM/NCBI) – "Simple Questions Your RAG System Can't Answer"

Dec 1 – Alexandra Fang (NINDS) – TBD

NIH Artificial Intelligence Symposium

- Broad range of topics – AI approaches in biomedical sciences
- Poster session, talks from NIH scientists, external keynotes
- Date: Friday, May 15th, 2026 (full day)
- Location: B10, Masur Auditorium

- Michael Chiang, MD – Director of NEI

https://www.nei.nih.gov/about/nei-leadership/michael-f-chiang

AI-driven Behavioral Phenomics in *Drosophila*: A Pipeline for Rare Disease Insights

Ryan O’Neill

Bioinformatics Community Fair

September 9th, 2025

Rare Disease

Ranges from 1 in ~2,000 to “N-of-1”

Collectively, all rare diseases affect many

Up to 1 in 10 people affected

25-30 million Americans affected

7,000 to 10,000 distinct conditions

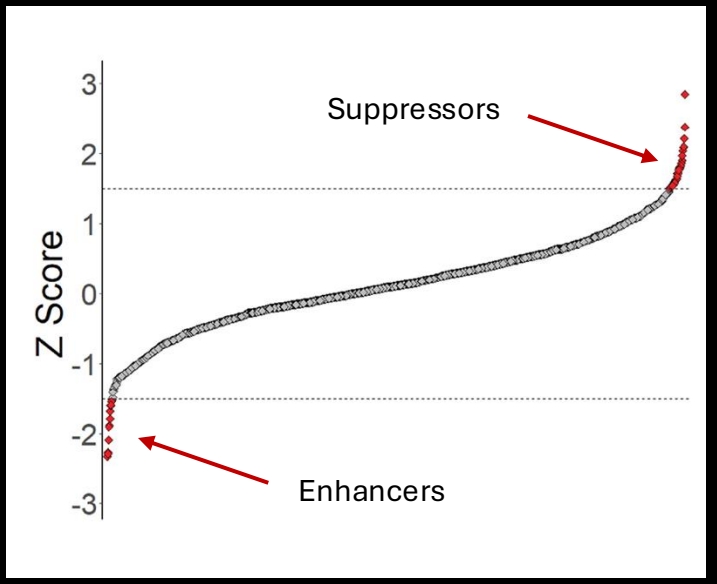
Drosophila has been widely used to model rare diseases

Undiagnosed Diseases Network

ABCA2	*FBXO32*	*POLR1B*
ACOX1	*GNAO1*	*RNF2*
ACSM5	*GPC4*	*RYBP*
APEX1	*GRB10*	*RYR3*
ARHGEF17	*HNRNPC*	*SCN4A*
ATP5F1D	*IRF2BPL*	*SETD5*
BICRA	*LZTR1*	*SETX*
CACNA1A	*MADD*	*SHROOM2*
CACNA1C	*MED12*	*SLC12A5*
CACNA1E	*MRPS12*	*SPTBN1*
CLCN7	*MTA3*	*TANC2*
CNTNAP1	*MYH11*	*TBX2*
COL5A1	*NACC1*	*TBX3*
CUL1	*NCOA2*	*TNS3*
DMXL1	*NOTCH3*	*USP7*
DROSHA	*NR5A1*	*WDR37*
EBF3	*NRBP1*	*WNT9B*
EIF2AK1	*NUDT11*	*WWP1*
EIF2AK2	*PHB*	*XRN1*
ETS1	*PIP5K1C*	

Clement Chow Lab
Drug repurposing screens

DPAGT1 Model



Disorder	Suppressor Drugs	Reference
NGLY1 deficiency	17	Hope *et al*. 2022 *PLoS Genet.* PMID: 35653343
DPAGT1-CDG	42	Dalton *et al*. 2024 *PLoS Genet.* PMID: 39466823
FAM177A1-related disorder	33	unpublished (*DROS25*)
MAN1B1-CDG	50	unpublished (*DROS25*)
SYNGAP1-related disorder	not reported	unpublished

Rare Disease Phenotyping Pipeline

Clinicians

Patients

Candidate Genes

Prioritization

Genes of Interest

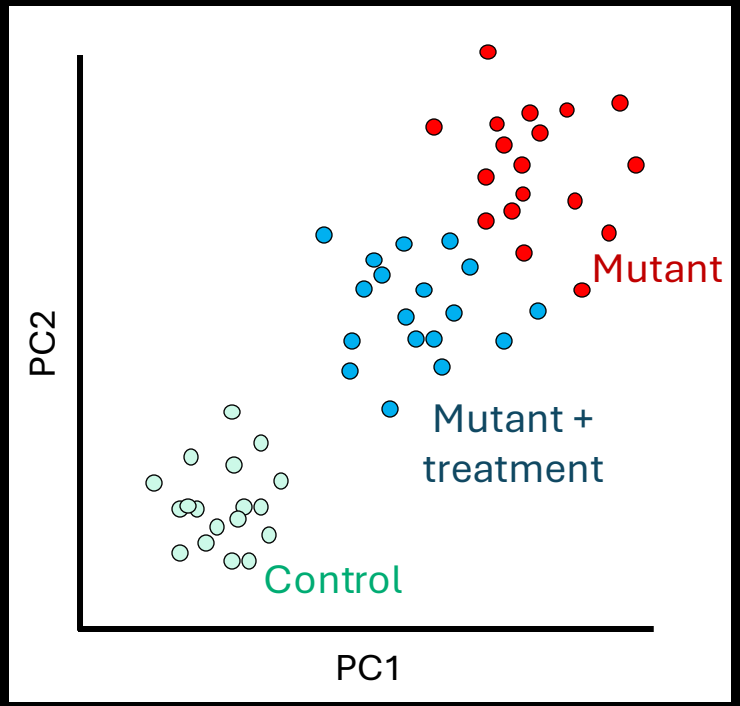
Fly Model

Humanization
Patient mutations

Behavioral Phenotyping

Screening

FDA-approved drugs
Genetic modifiers

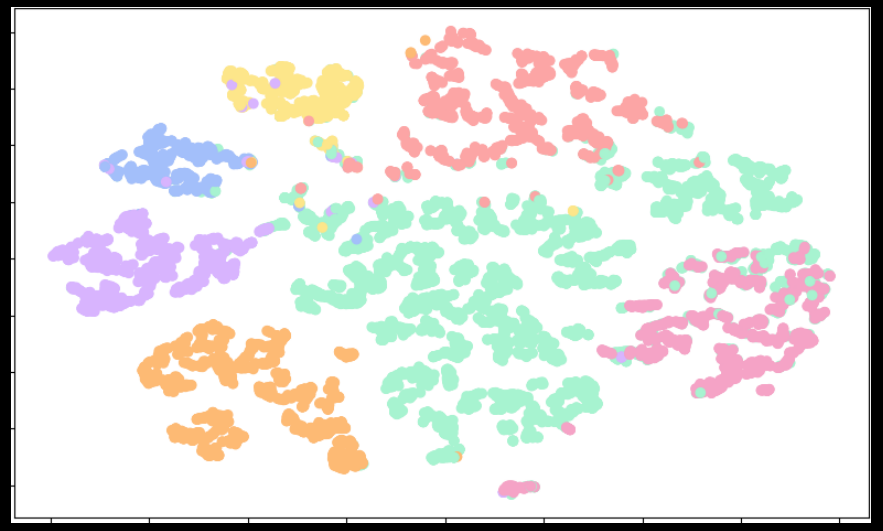


AI-driven Behavioral Phenotyping

Behavioral Recordings

Building a recording platform

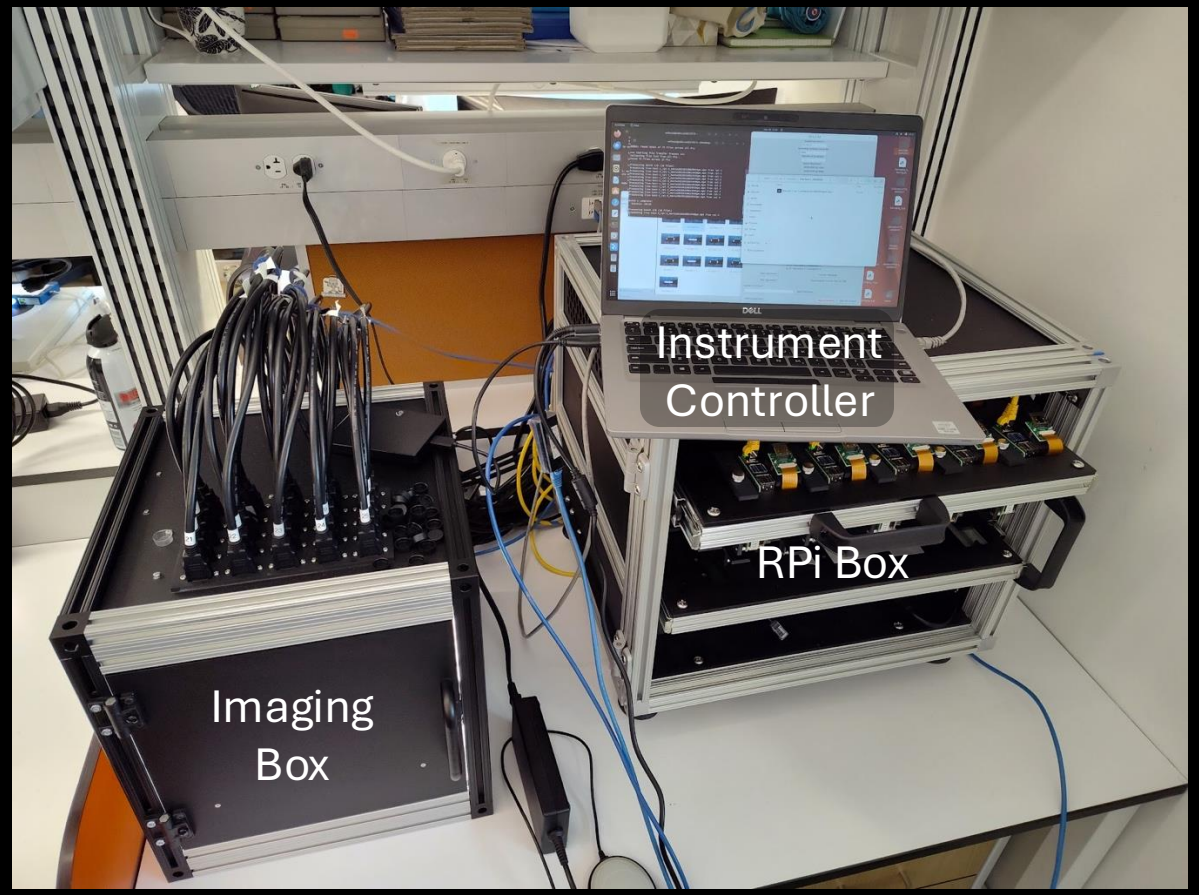
AI-assisted Analysis and Embedding

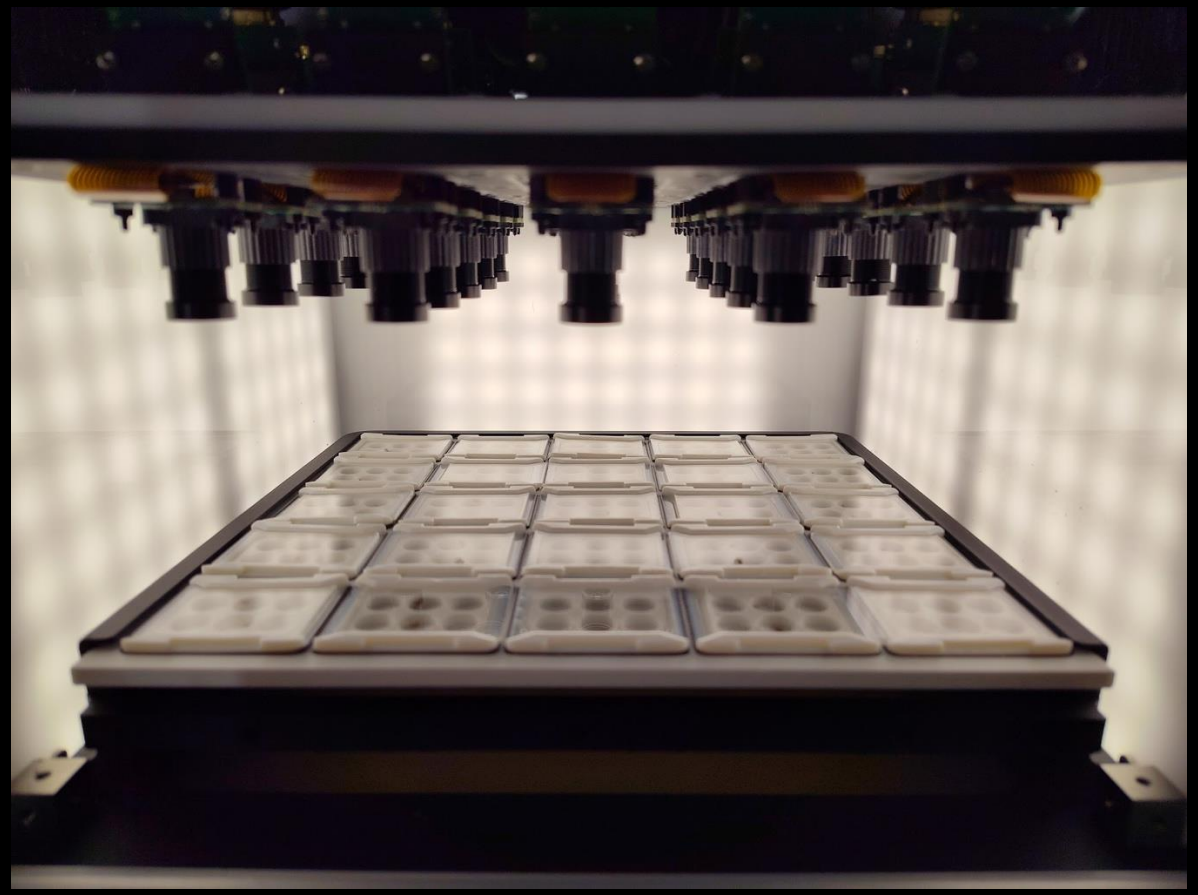


Building an AI-based analysis pipeline

High-throughput Recording Platform

6 Flies/camera x 25 cameras = 150 flies simultaneous recording





Built in collaboration with NIBIB – Ghadi Salem, Marcial Garmendia-Cedillos, Peter Donley

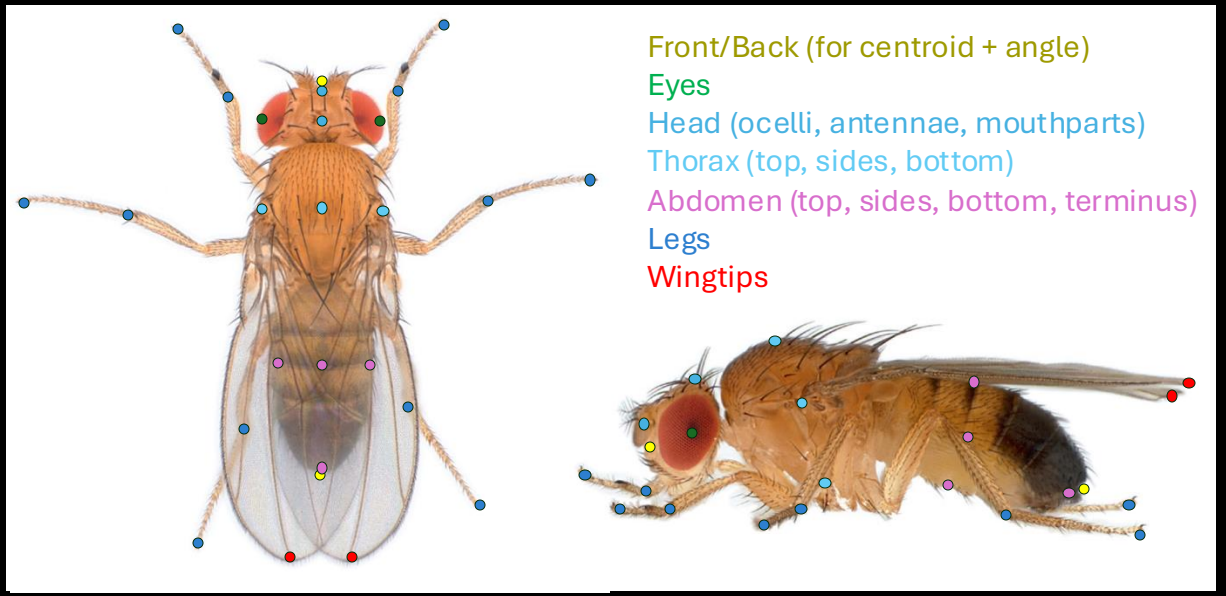
Movie to data pipeline – Keypoint Tracking

600 x 600 px, 40 fps, ~30 min per movie

DeepLabCut

Keypoint tracking via deep learning

- 5000+ annotated frames
- 8 diverse-looking phenotypes
- ~6.5 pixels average error

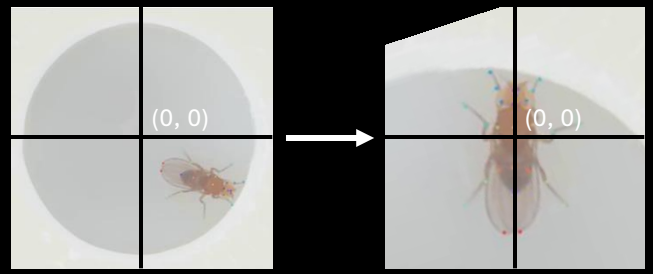


Movie to data pipeline – Data Correction and Feature Engineering

Body part tracking
30 Keypoints

scorer	DLC_resnet	DLC_resnet	DLC_resnet	DLC_resnet	DLC_resnet	DLC_resnet	DLC_resnet	DLC_resnet	DLC_resnet	DLC_resnet	DLC_resnet	DLC_resnet	DLC_resnet	DLC_resnet	DLC_resnet	DLC_resnet	DLC_resnet
bodyparts	Front	Front	Front	Back	Back	Back	Ocelli	Ocelli	Ocelli	Antennae	Antennae	Antennae	Mouthparts	Mouthparts	Mouthparts	EyeLeft	
coords	x	y	likelihood	x	y	likelihood	x	y	likelihood	x	y	likelihood	x	y	likelihood	x	
0	502.885	419.349	0.999953	388.967	382.4698	0.99998	487.8641	413.9288	0.999744	497.1884	419.499	0.999833	502.9074	423.503	0.673583	494.8134	
1	502.937	418.0227	0.999964	388.7175	382.2024	0.999974	488.4829	412.1895	0.999755	497.487	418.4601	0.999852	501.7632	422.4281	0.831993	495.2547	
2	502.9601	415.1848	0.999902	388.2787	382.1347	0.999972	488.9488	409.1083	0.999773	498.0264	415.7701	0.999652	501.5386	420.2477	0.84197	495.588	
3	502.8574	413.6837	0.999879	389.1759	381.9422	0.999966	488.6399	407.4658	0.99968	497.7626	413.4435	0.999733	501.8895	419.8446	0.868455	496.5298	
4	502.6349	413.1623	0.999859	389.0331	382.1003	0.999966	488.3416	406.9432	0.99978	497.2526	412.8792	0.999667	501.7329	419.3875	0.911098	496.1295	
5	502.7465	413.0801	0.999871	388.1978	382.0906	0.999971	488.4386	406.8627	0.99977	497.4548	412.8555	0.999695	501.7666	419.4689	0.912677	496.169	
6	502.7116	413.1925	0.999871	388.1146	382.0616	0.999971	488.2944	406.9591	0.999768	497.2859	412.8163	0.99969	501.5673	419.5194	0.91897	496.1151	
7	502.9011	413.4367	0.999921	388.1275	382.1674	0.999973	488.5269	407.0564	0.999729	497.6709	412.812	0.999797	501.0549	419.6125	0.8776	496.4909	
8	503.0785	413.3877	0.999934	388.6765	382.2581	0.999975	488.7873	406.9232	0.999731	497.9628	412.7855	0.99983	500.9885	419.5495	0.852414	496.7571	
9	502.9052	413.2551	0.999946	388.9716	382.2383	0.999976	488.6602	406.8789	0.999749	497.8009	412.6438	0.999856	500.8841	419.6115	0.865095	496.5835	
10	502.7413	413.425	0.999941	388.9077	382.0596	0.999976	488.5829	407.0427	0.999749	497.648	412.8155	0.999845	500.8135	419.7059	0.847962	496.507	
11	502.9453	413.2138	0.999953	388.6594	382.2228	0.99998	488.7181	406.8855	0.999766	497.851	412.5959	0.999871	500.9568	419.588	0.854747	496.4963	
12	502.4672	413.3636	0.999947	388.2699	382.3387	0.999978	488.1774	406.7685	0.999816	497.2158	412.7367	0.99983	500.6686	419.4135	0.858121	496.0435	
13	498.5699	414.5673	0.999732	384.8725	382.1981	0.999962	484.4117	406.9449	0.999906	491.9947	412.8058	0.999431	497.1123	418.1543	0.855722	491.0782	
14	494.4693	412.8408	0.999607	381.8682	381.7635	0.999824	479.746	405.8927	0.999848	488.7782	411.9562	0.999364	494.5702	418.172	0.676234	487.1539	
15	491.5294	415.6931	0.999048	378.8183	380.7624	0.99973	475.4591	407.0788	0.999811	485.9374	413.3419	0.998961	491.011	419.3163	0.747528	482.3954	
16	485.5515	420.1699	0.999892	377.2686	379.7195	0.99987	470.445	411.7428	0.999791	480.0176	419.3163	0.998894	484.6495	423.4195	0.875754	478.8849	
17	482.6326	426.6618	0.99944	374.3362	377.9793	0.999976	467.726	419.1453	0.999812	477.1679	423.8184	0.997296	481.924	431.4561	0.798784	478.9178	
18	478.6959	431.2432	0.999746	374.0807	375.7523	0.999983	466.2025	423.8027	0.999062	475.8662	430.8143	0.998384	479.4286	434.3876	0.599132	476.3362	
19	477.9242	438.6315	0.999879	374.9133	374.5121	0.99998	466.3041	430.9155	0.999627	474.0578	436.2186	0.999719	478.4567	440.4145	0.540891	476.6147	
20	475.6879	441.6887	0.998866	374.8244	374.5076	0.999982	463.0591	435.0469	0.998715	473.004	440.4292	0.998731	474.6927	447.7867	0.505478	475.8588	
21	469.9376	447.9775	0.999809	373.2002	373.0364	0.999976	460.7145	438.325	0.998384	467.5789	446.6276	0.998943	470.0781	451.3479	0.866403	469.7127	
22	466.6922	452.524	0.999912	372.5408	373.4641	0.999975	456.9535	441.002	0.997717	464.8092	451.2085	0.999519	467.7841	455.0665	0.888335	467.9687	
23	465.0941	455.139	0.999597	371.5529	373.7911	0.999976	454.1608	443.8138	0.99967	462.9557	452.9712	0.998694	464.8823	458.7636	0.797205	465.4624	
24	464.7359	455.9685	0.999437	371.3419	373.8883	0.999977	453.0569	445.2258	0.999648	461.616	454.3458	0.998756	462.9982	459.4627	0.841623	465.5697	
25	464.0856	457.0011	0.99972	371.1979	374.1946	0.999974	452.6729	447.1133	0.999445	462.0604	454.491	0.998525	461.3628	461.5451	0.857646	465.4579	
26	462.7097	460.4417	0.999557	371.938	371.7188	0.99997	452.4099	450.6112	0.999842	460.7062	458.271	0.99919	460.173	464.286	0.682608	464.5409	
27	456.1834	466.0897	0.999931	376.1634	368.431	0.999878	449.0285	456.219	0.99903	452.7658	463.1537	0.999681	456.169	467.9077	0.516301	459.1317	
28	451.0095	469.8626	0.999937	376.823	366.8558	0.999501	444.2592	458.9155	0.99959	447.8813	465.9584	0.999781	448.9008	470.8125	0.19158	456.3707	
29	446.7812	473.7262	0.999925	379.263	367.6083	0.999551	438.724	462.3985	0.999575	443.7196	471.1982	0.999693	445.8278	473.7039	0.123124	455.7165	
30	441.8109	477.1819	0.999856	382.6677	367.0063	0.999464	435.3181	463.5611	0.999602	440.9979	474.0752	0.999602	445.4514	476.4407	0.208142	451.5012	
31	441.1667	481.7407	0.999952	384.225	369.0339	0.999892	434.6921	467.2525	0.999773	439.6273	477.9441	0.99968	440.5976	482.0141	0.175476	449.4809	
32	438.8895	487.538	0.999987	386.0198	372.0703	0.999965	433.1557	472.3989	0.999434	436.189	481.6972	0.999971	435.877	486.2638	0.123878	447.5934	
33	434.2984	491.3657	0.999942	386.4539	375.3531	0.999973	430.4365	477.1297	0.999116	431.4067	487.7824	0.999892	429.5986	491.6757	0.138104	444.2582	
34	432.2958	496.2263	0.99993	387.408	380.2594	0.999949	427.3951	481.864	0.999737	432.3237	492.755	0.99951	429.7378	495.8221	0.1239	441.2364	
35	432.3783	499.9211	0.999936	388.0741	384.6266	0.999877	427.0014	486.6881	0.999394	430.6985	496.1763	0.999844	428.7428	499.9381	0.024848	440.9285	
36	431.7075	504.8395	0.999667	390.385	388.7244	0.999972	426.7683	491.7487	0.999207	429.7602	500.0888	0.999765	432.8013	503.8424	0.027123	442.0759	
37	434.3242	510.1875	0.999384	390.7084	392.0141	0.999967	427.3802	495.6452	0.999272	432.4044	506.9041	0.998858	434.8695	506.5667	0.018935	441.5723	
38	431.7954	509.6721	0.999589	390.1999	390.4272	0.999984	424.3638	495.0287	0.99952	429.6002	504.6178	0.99925	434.7321	506.3306	0.040022	439.5193	
39	424.3853	506.8017	0.999711	388.2554	386.1768	0.999968	417.3804	492.5048	0.99986	421.4631	501.8699	0.999775	427.9997	506.1195	0.04909	432.045	
40	420.5295	502.006	0.999934	386.3698	382.0552	0.999926	416.2281	487.7749	0.999529	417.4211	496.2382	0.999778	418.186	500.2773	0.051655	429.0087	
41	415.6698	498.4917	0.99973	383.245	377.3268	0.999898	413.5034	483.8085	0.998703	415.0435	494.7571	0.99834	412.9023	499.3908	0.054994	425.6251	
42	415.0649	494.4948	0.998897	381.7584	373.8303	0.999744	410.2724	480.0318	0.992093	412.9788	491.1339	0.998352	410.8141	495.4314	0.272457	422.9596	
43	406.8986	489.0119	0.999604	379.5433	367.4518	0.998686	403.9575	475.8709	0.999631	404.8517	485.1391	0.999708	407.6287	488.1901	0.012675	418.5275	
44	403.5586	487.381	0.999896	377.8864	365.2408	0.998643	401.7552	474.4239	0.999186	401.9223	482.1928	0.999814	403.4801	484.2997	0.013286	415.3378	
45	398.5274	485.5766	0.99986	377.2872	362.2324	0.999304	396.4263	472.2124	0.998781	396.9422	481.8106	0.999542	394.9057	484.8111	0.011517	409.3459	
46	389.7649	485.0131	0.999863	377.2677	359.8697	0.999619	389.2027	471.8311	0.999122	389.5229	481.6834	0.999447	391.6077	483.8206	0.0056	403.2659	
47	380.2789	484.3229	0.999891	381.379	359.1276	0.999751	381.8727	470.278	0.999508	380.3519	481.1073	0.999543	386.7029	483.38	0.006603	394.973	
48	367.5927	479.6655	0.999685	387.4828	357.0806	0.999981	372.3278	466.6292	0.999813	370.1989	477.1808	0.999196	363.3562	480.3102	0.003626	386.2164	
49	362.2466	479.0407	0.999852	392.9302	356.5551	0.999976	368.0109	465.4123	0.999666	364.2713	476.1305	0.99969	362.5373	481.179	0.003347	381.0349	
50	355.629	477.7004	0.999927	393.5261	356.6196	0.999977	360.7093	464.1641	0.999554	356.9422	474.3557	0.999814	360.5346	479.8934	0.003078	374.5815	
51	347.4719	479.1569	0.999943	393.1272	360.0515	0.999954	354.4528	465.9471	0.999848	348.9744	476.0815	0.999942	347.2832	483.6126	0.006319	365.1933	
52	341.7094	479.5903	0.999948	390.765	362.4062	0.999932	348.6892	465.9274	0.999936	343.7624	476.3917	0.999823	347.1244	484.1906	0.008422	360.8219	
53	337.5759	480.5319	0.999944	388.4496	364.4433	0.999911	343.7379	467.1538	0.999878	338.9232	477.9345	0.999848	345.8716	485.3407	0.01413	357.7772	
54	334.156	482.9561	0.999965	385.2701	367.4315	0.999975	340.6093	469.7868	0.999815	335.2542	480.8809	0.999858	342.9653	486.2364	0.015578	354.904	

Raw Keypoints data
(x, y, likelihood)



Position/angle correction

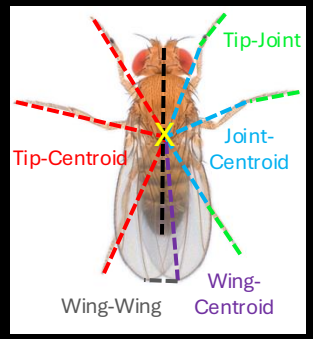
AI-based analysis

1. Behavior Label Prediction
2. Genotype Embedding

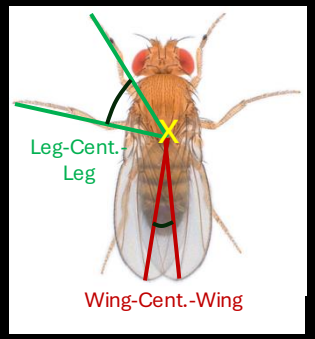
829 features per frame

62500 frames per movie

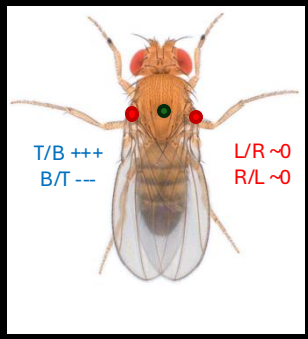
Lengths



Angles



Log Likelihood Ratios



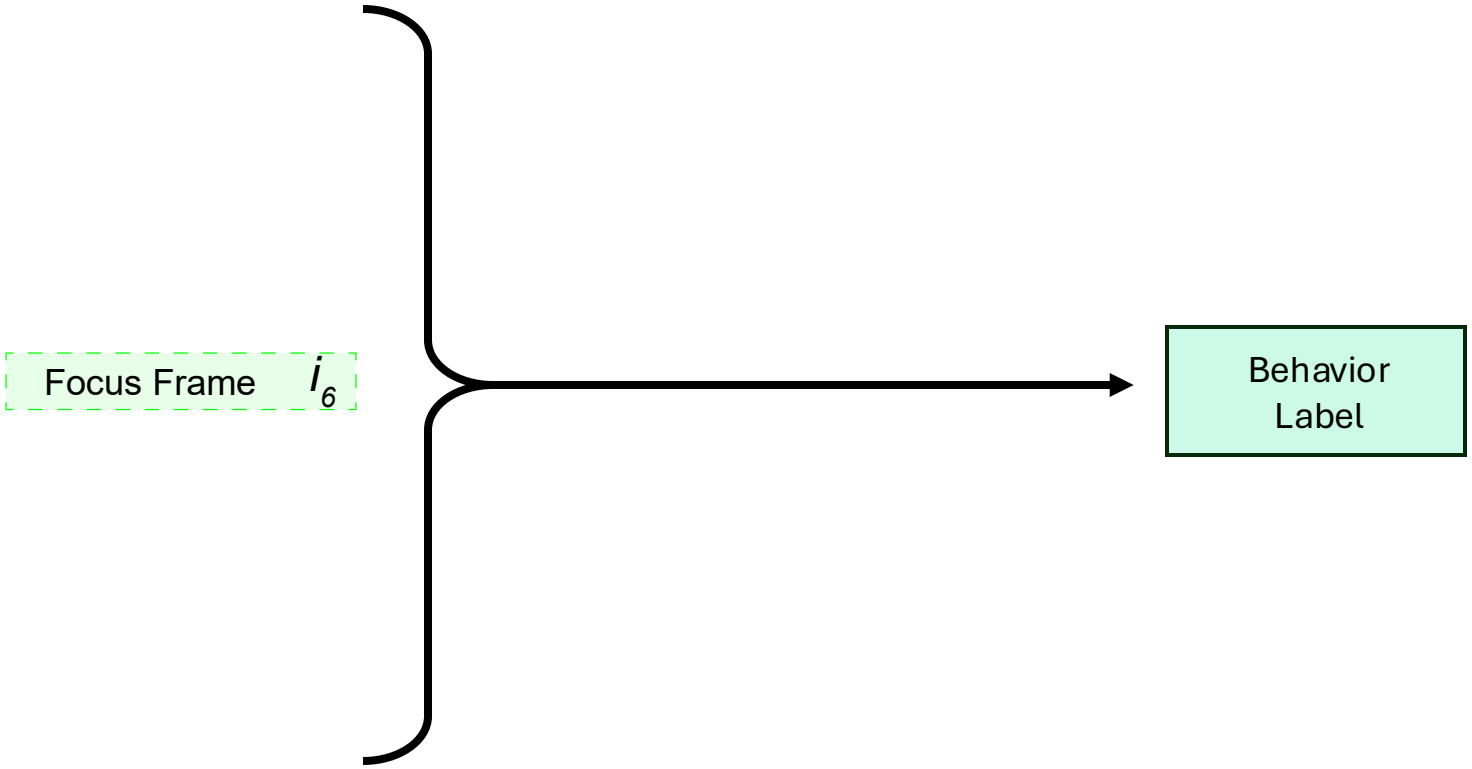
Feature Engineering

Hypothesis:
Mutations cause behavioral changes

1. Behavior Label Prediction:
   - Train a network to give a behavior label to every frame of a movie
   - Analyze the behavior tracks

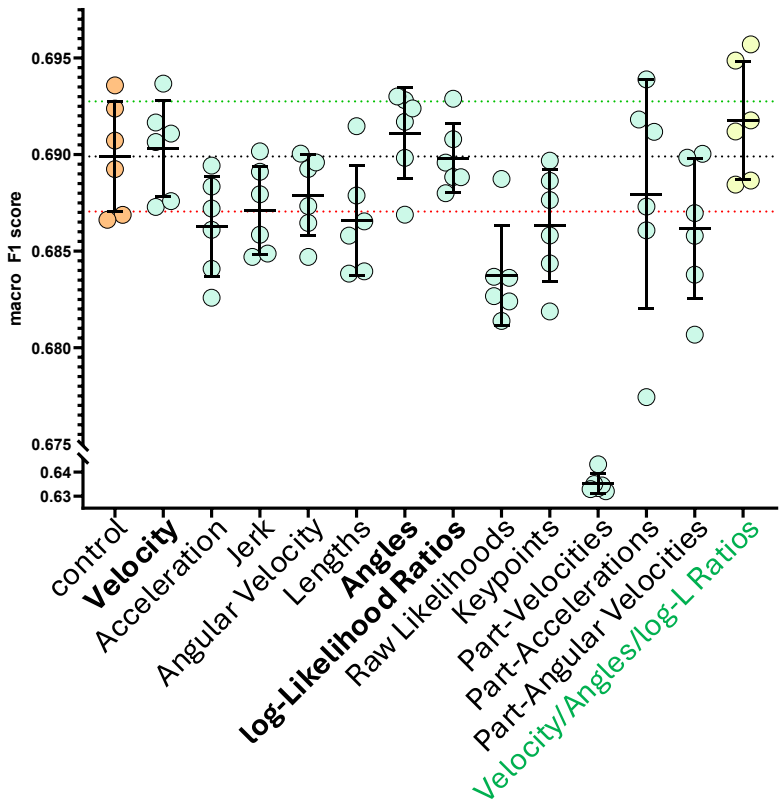
- Standing
- Walking
- Jumping
- Scrambling
- Groom – Head
- Groom – Front Legs
- Groom – Side Leg
- Groom – Wings
- Groom – Abdomen
- Groom – Back Legs

Behavior Labeling Neural Network Architecture

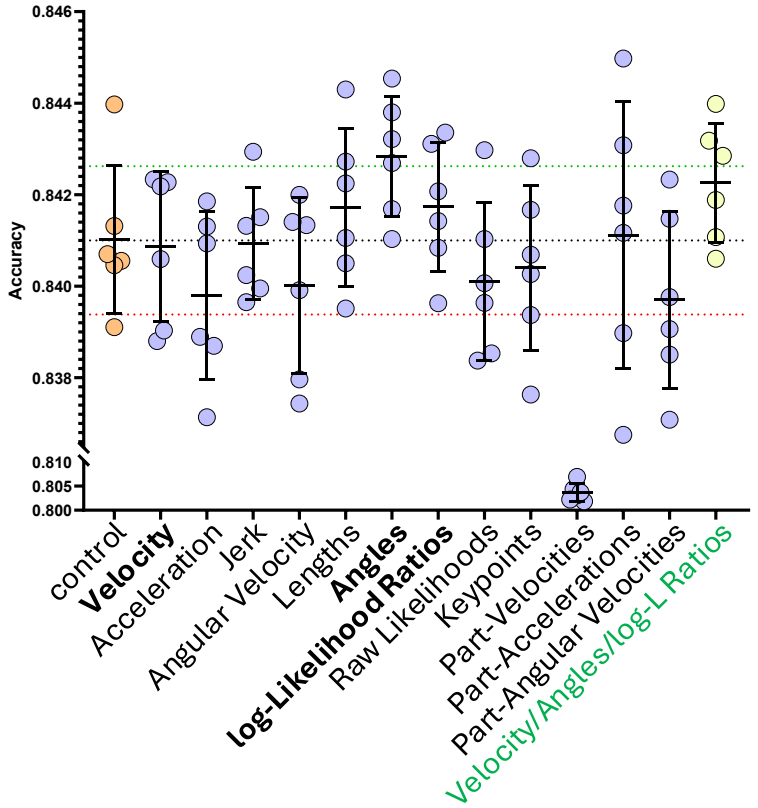


Dataset Ablation Reveals Critical Input Features

Macro F1



Accuracy



Behavior Labeling Accuracy

Recall →

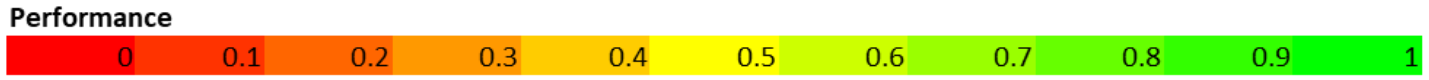
Precision ↓

Prediction

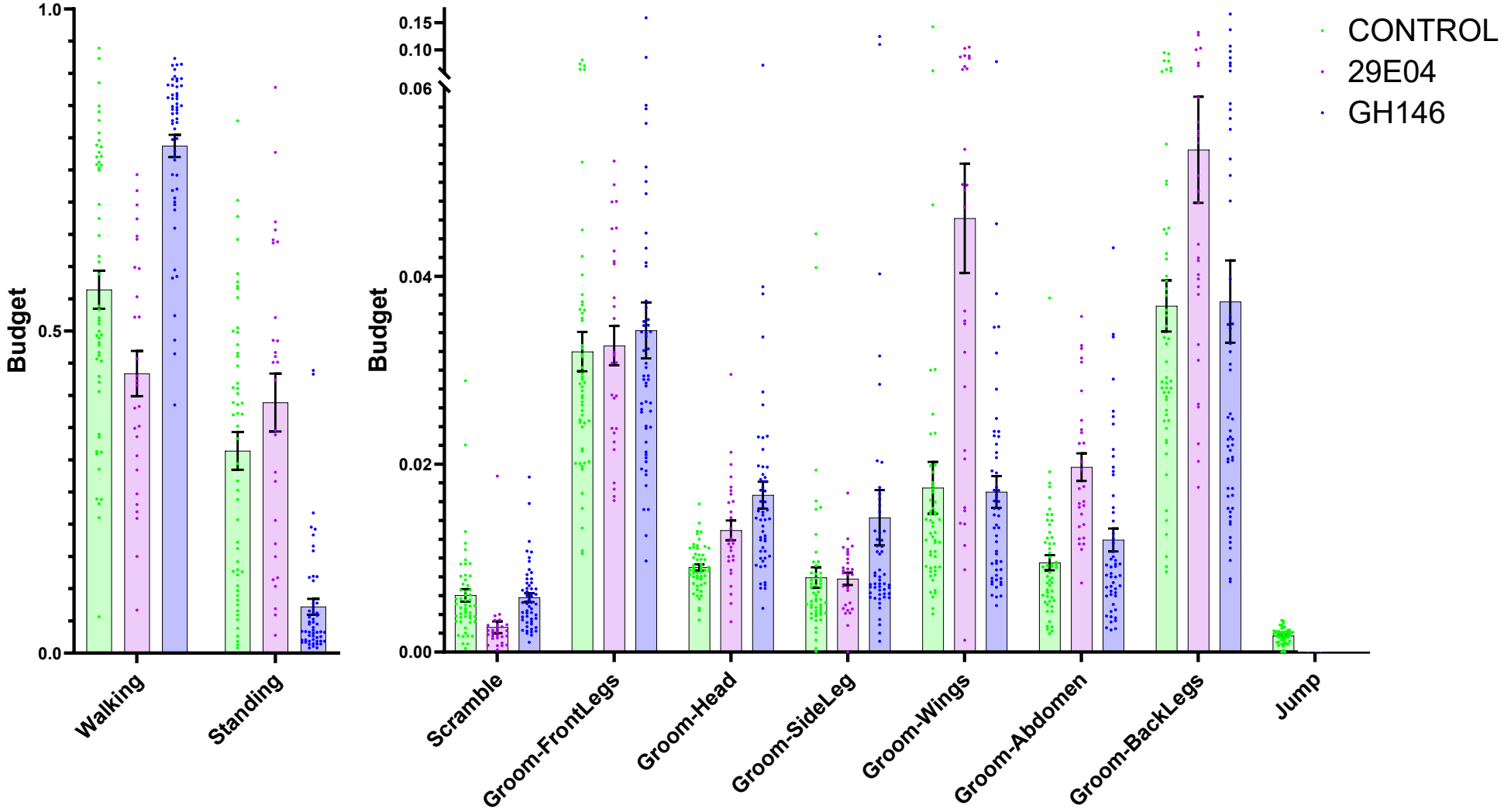
Ground Truth	Groom-Abdomen	Groom-BackLegs	Groom-FrontLegs	Groom-Head	Groom-SideLeg	Groom-Wings	Jump	Scramble	Standing	Walking
Groom-Abdomen	**0.69**	0.19	0.00	0.00	0.00	0.07	0.00	0.00	0.02	0.02
Groom-BackLegs	0.08	**0.67**	0.00	0.00	0.00	0.06	0.00	0.00	0.04	0.13
Groom-FrontLegs	0.00	0.00	**0.80**	0.07	0.02	0.00	0.00	0.00	0.09	0.02
Groom-Head	0.00	0.00	0.12	**0.83**	0.01	0.00	0.00	0.00	0.03	0.00
Groom-SideLeg	0.00	0.00	0.27	0.06	**0.63**	0.00	0.00	0.00	0.02	0.03
Groom-Wings	0.08	0.06	0.00	0.00	0.00	**0.81**	0.00	0.00	0.03	0.02
Jump	0.00	0.01	0.00	0.00	0.00	0.09	**0.23**	0.34	0.04	0.29
Scramble	0.00	0.00	0.00	0.00	0.00	0.00	0.02	**0.85**	0.00	0.13
Standing	0.01	0.04	0.06	0.03	0.01	0.02	0.00	0.00	**0.73**	0.10
Walking	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.04	**0.93**

Prediction

Ground Truth	Ceiling	Floor	Wall-Down	Wall-Side	Wall-Up
Ceiling	**0.91**	0.00	0.06	0.01	0.02
Floor	0.00	**0.96**	0.00	0.02	0.02
Wall-Down	0.16	0.01	**0.76**	0.05	0.01
Wall-Side	0.01	0.01	0.01	**0.88**	0.09
Wall-Up	0.02	0.04	0.00	0.09	**0.86**



Behavior Label Prediction Can Reveal Differences Between Genotypes



Hypothesis:
Mutations cause behavioral changes

2. Genotype Embedding:

- Allow the AI to determine the distinguishing features between genotypes
- Create a “map” linking behaviors to genotypes

AI-based Analysis – Genotype embedding

Train a neural network that maps behavior to genotype, allowing for suppressor screens

Control

vs.

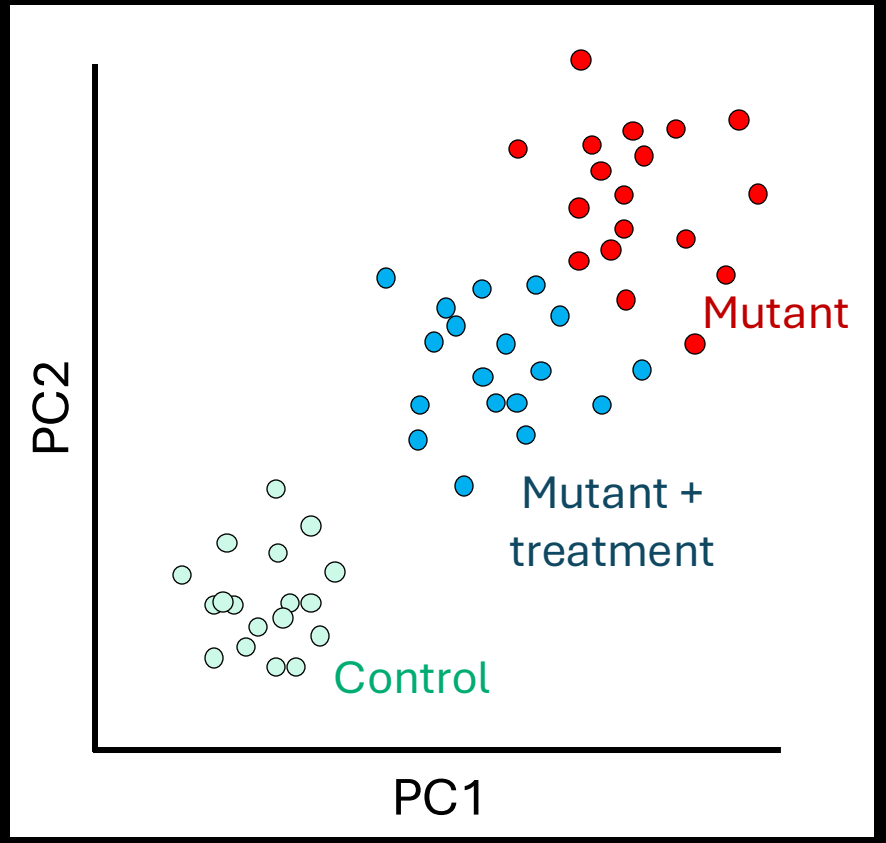
Mutant

vs.

Mutant + treatment

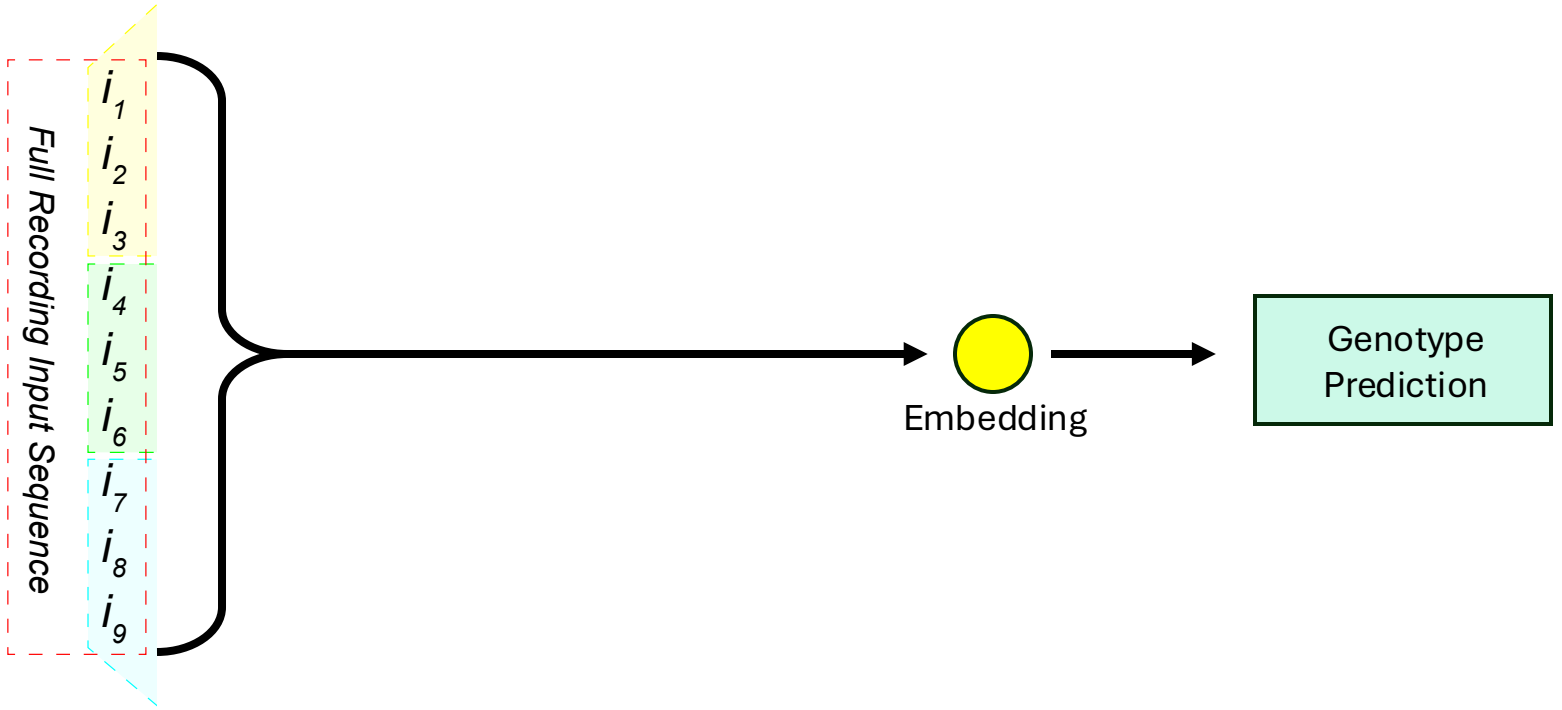
Automated phenotyping platform

AI-based phenotype embedding



Identify treatments that make mutant more "control-like"

AI-based Analysis – Genotype Embedding Neural Network Architecture



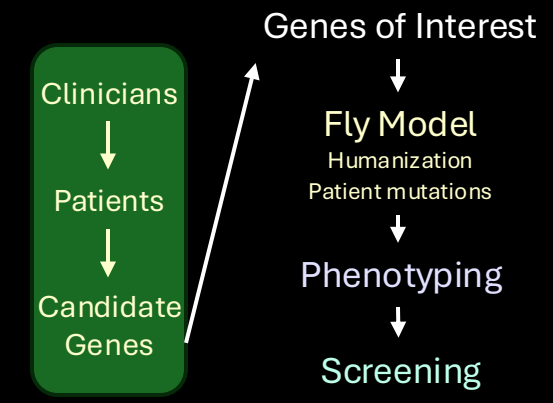
Actual inputs are 62,500 frames
(250 chunks of 250 frames each)

AI-based Analysis – Genotype Embedding network, initial results

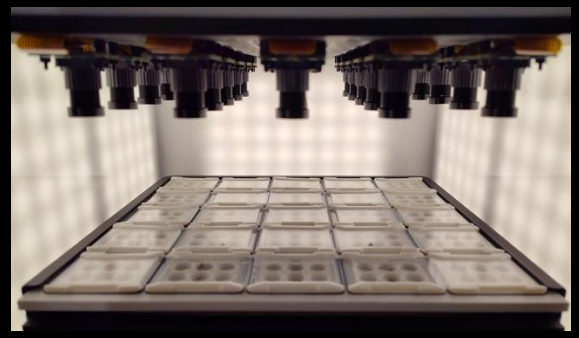
Network trained on 6 mutants (plus controls) – embedded into 512-dimensional space
~4000 flies, ~3500 hours of video

Summary

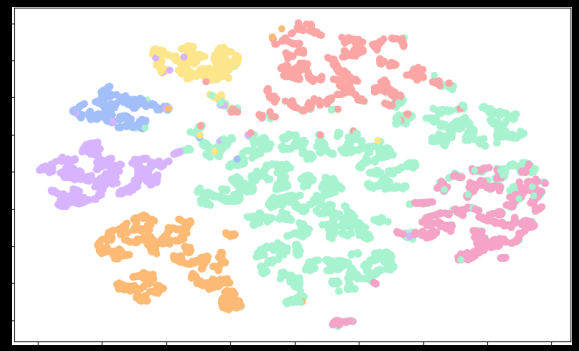
Rusan Lab is developing a phenotyping core for Rare Disease



- Humanized *Drosophila* disease modeling



- Scalable platforms for direct recording



- AI-based analysis for suppressor screens

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