



NTCO AGM 2024

Introduction To Teledyne FLIR & Success Stories

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Senior Engineering Manager

FEBRUARY 2024

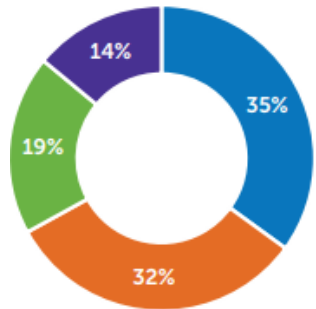
TELEDYNE FLIR OVERVIEW

TELEDYNE TECHNOLOGIES

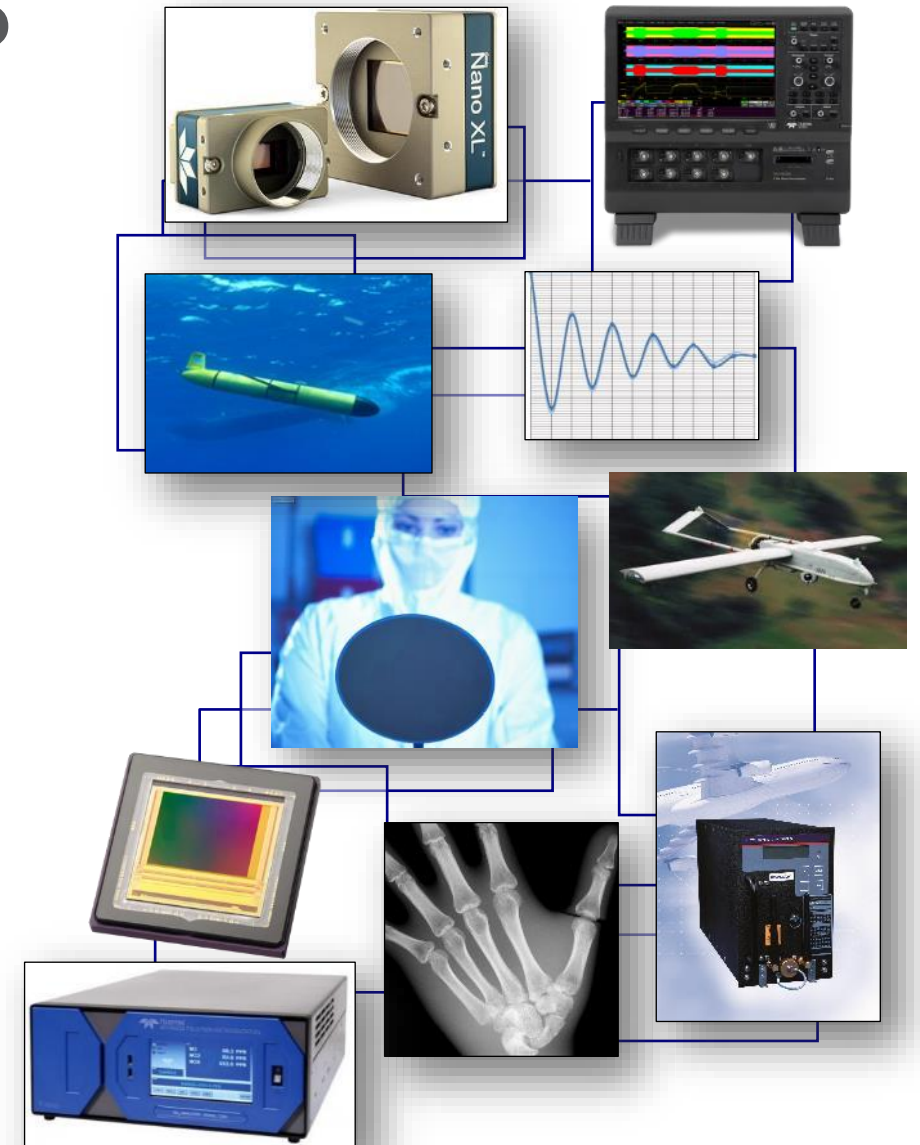
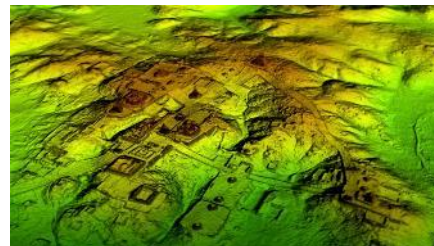


WHO WE ARE

- » Teledyne is a leading electronics, instrumentation and engineering focused company with headquarters in Thousand Oaks, CA.
- » Publicly traded company, Teledyne had revenue of \$4.614B in 2022 and ~ 14,500 employees.



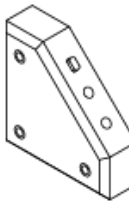
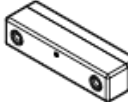


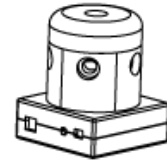
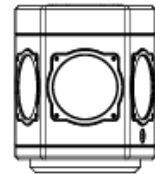
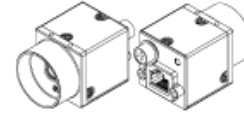
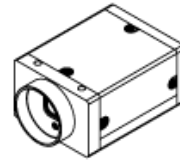

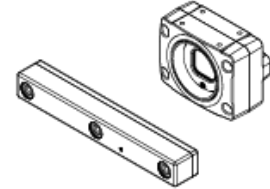
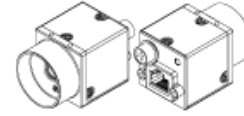


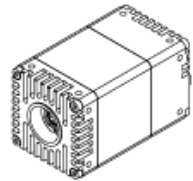

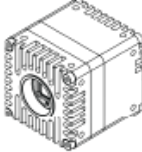
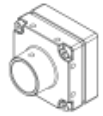


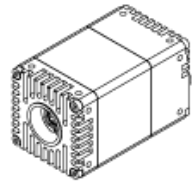

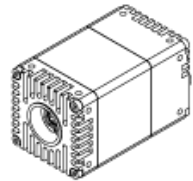

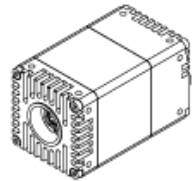
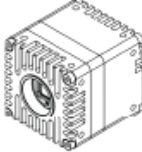
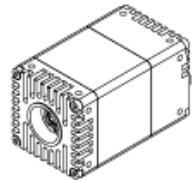
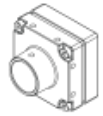
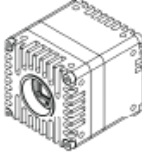
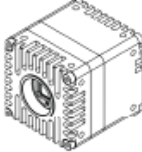
- Instrumentation
- Digital Imaging
- Aerospace and Defense Electronics
- Engineered Systems



25 YEARS OF MACHINE VISION INNOVATION

Starting out as Point Grey Research in 1997, the Teledyne FLIR machine vision team is a key provider of machine vision, spherical, stereo and people counting cameras around the world.



Year	Product/Innovation	Image
2000	First IEEE 1394 stereo vision camera Digiclops	
2001	First IEEE 1394 imaging camera Firefly	
2002	First spherical vision camera Ladybug First binocular stereo vision camera Bumblebee	 
2004	First IEEE 1394b camera Dragonfly Express	
2005	New products Dragonfly2 Ladybug2	
2006	New products Flea2 Firefly MV Bumblebee2	
2007	New products Grasshopper FirePRO	
2008	New product USB 2.0 camera Chameleon New product Ladybug3	 
2009	World's first USB 3.0 Camera	
2010	New product Flea3 New product GigE camera Grasshopper2	 
2011	First Camera Link camera Gazelle First USB 3.0 camera Flea3 World's smallest GigE camera Flea3 New product Grasshopper Express	  
2012	New Product IP camera Zebra2 World's Smallest PoE GigE Camera Blackfly	 
2013	New USB3 products Ladybug5 Grasshopper3	 
2014	New USB3 product Blackfly USB 3.0 New GigE product Grasshopper3	 
2015	New USB3 product Chameleon 3	
2016	New USB3 and GigE Vision product Blackfly S	
2017	10 GigE Camera Oryx	
2018	Board-level Blackfly S	
2019	Industry's First Deep Learning Camera Firefly-DL APS-C Oryx	 
2020	New 10GigE Form Factor Oryx	

SOME OF OUR CUSTOMERS



Electronics & Semiconductor



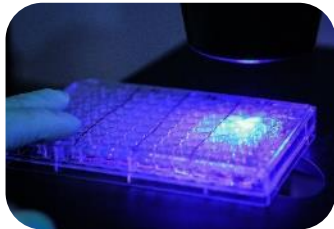
Food, Beverage, Pharmaceuticals



Entertainment



Industrial



Medical & Life Science



Metrology



Robotics



Traffic



Logistics



Aerial



Surveillance



Space

CUSTOMER STORY

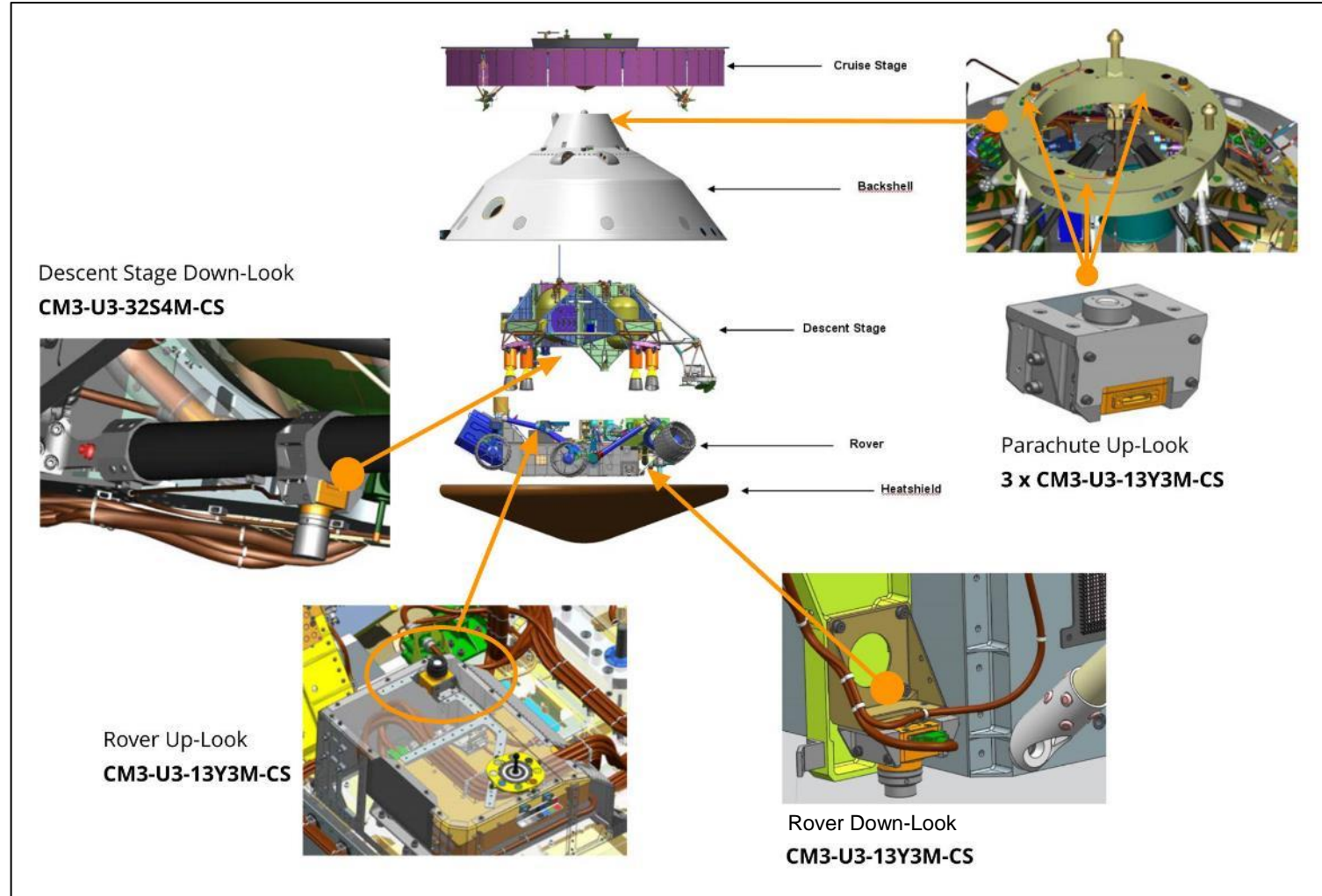
TELEDYNE FLIR ON MARS!

- NASA successfully launched their Mars 2020 mission on an Atlas V Rocket
- NASA's most "camera dense" mission with 23 total cameras
- There were 6 FLIR cameras !
- First time our cameras are subjected to extreme temperature & gravity forces
- Prove our product quality was good and process was robust to ensure consistency



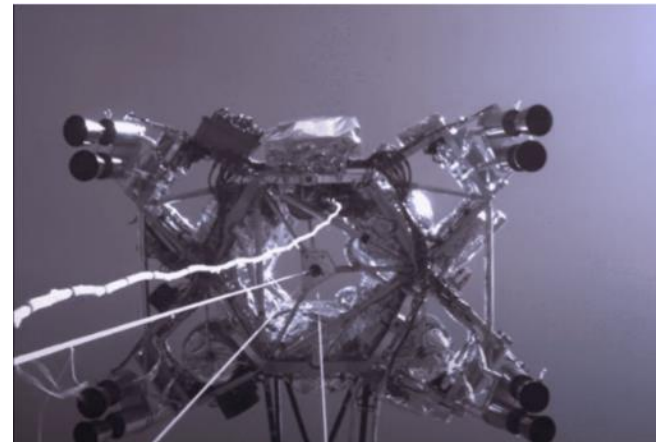
ENTRY, DESCENT & LANDING (EDL) CAMERAS

- Looking for COTS cameras – low cost, ease of system integration
- Parachute up-look cameras will watch how the parachutes deploy
- Descent stage down-look cameras will watch how the rover is lowered
- Rover up and down-look cameras will record the rovers progress as it is lowered from the descent stage
- Parachute and descent stage cameras will be jettisoned with the back shell and descent stage



NASA ROVER LANDING ON MARS

NASA successfully landed the Perseverance Rover on Mars on February 18, 2021



NTCO PROGRAM

INTERNSHIP TOPICS & TECHNOLOGIES

- Topics

- Optical camera test equipment
- Software development for new cameras
- Deep learning network optimization
- Deep learning use cases

- Technologies

- Zemax, optical bench design
- Deep learning, Tensorflow, Caffe
- C++, Python, ROS

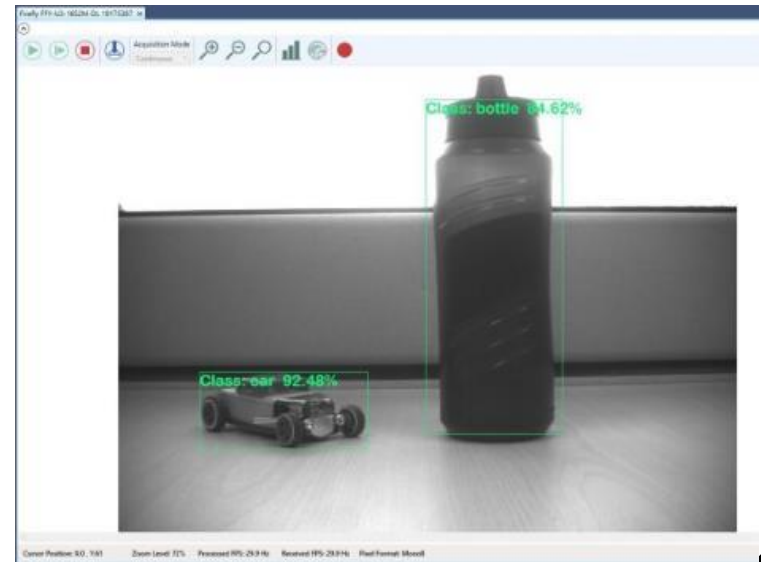
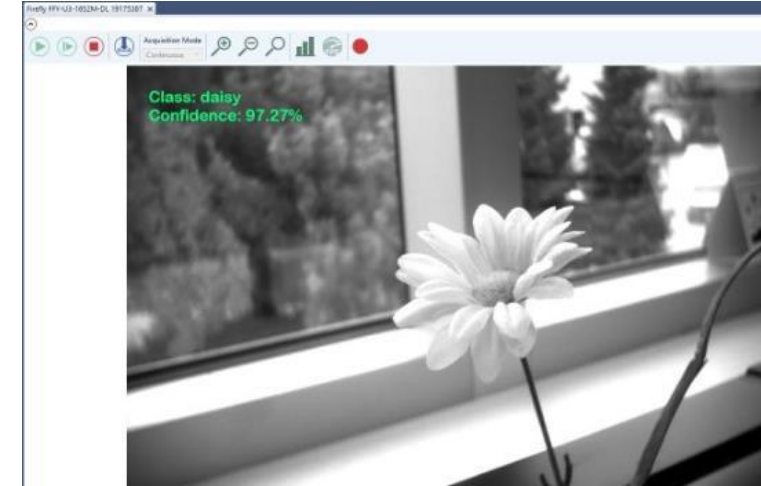


DL MODEL UTILITY

- NeuroUtility tool for Firefly DL camera
 - DL model conversion & upload
 - DL model verification



Firefly DL camera



Tensorflow Neural Network Conversion ?

NEUROUTILITY

.pb File:	Desktop\tensorflow-for-poets-2-master\tf_files\retrained_graph.pb
Network Input Width (px):	224
Network Input Height (px):	224
# of Channels:	3
Input Layer:	input
Output Layer Name:	final_result
Output Directory:	C:\Users\wgalleo\Desktop\tensorflow-for-poets-2-master\tf_files
Converted File Name:	Conv_FFY_DL_Network

WELCOME

SETUP

CONVERT

VERIFY

DEPLOY

.pb

➔

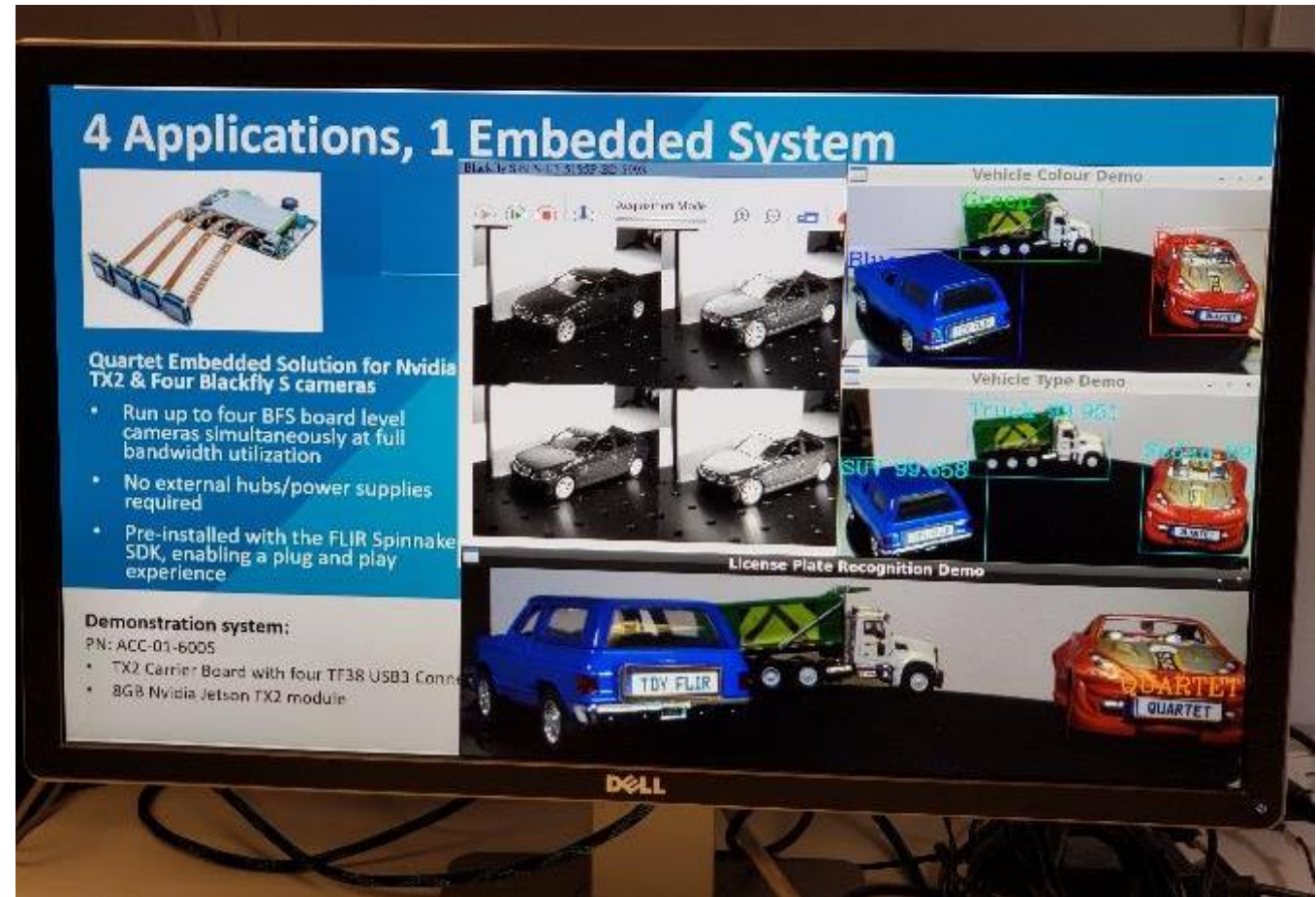
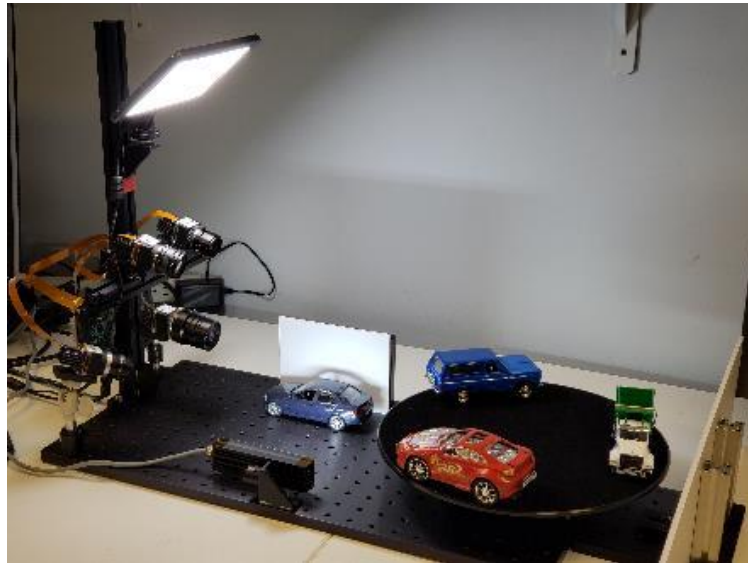
Click to Convert

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Result

DL MODEL TRAINING

- ITS (Intelligent Transportation System) applications
 - Vehicle type recognition
 - Vehicle colour recognition
 - License plate recognition
- Demo at Vision Stuttgart 2021



NTCO STUDENTS

Student name	University	Program	When	Arrangement
Stephanie Monty	U Vic	B.Sc.	July – August 2018	In-person
Tarun Kumar	U Vic	Ph.D.	May – July 2019	In-person
Nikita Shymberg	U Vic	B.Sc.	May – August 2019	In-person
Kelvin Shao	U Vic	B.S.Eng.	September – December 2019	In-person
Gursewak Singh	U Vic	B.Sc.	January – April 2020	In-person -> remote
Rehan Hafeez	UBC	B.A.Sc.	July – August 2020	Remote
Robert Bickley	U Vic	Ph.D.	September – December 2020	Remote
Viraja Khatu	Western U	Ph.D.	February – April 2021	Remote
Ridhee Gupta	U Waterloo	B.Sc.	May – August 2021	Remote
Jennifer Vlaar	U Vic	B.S.Eng.	June – August 2023	In-person



THANK YOU