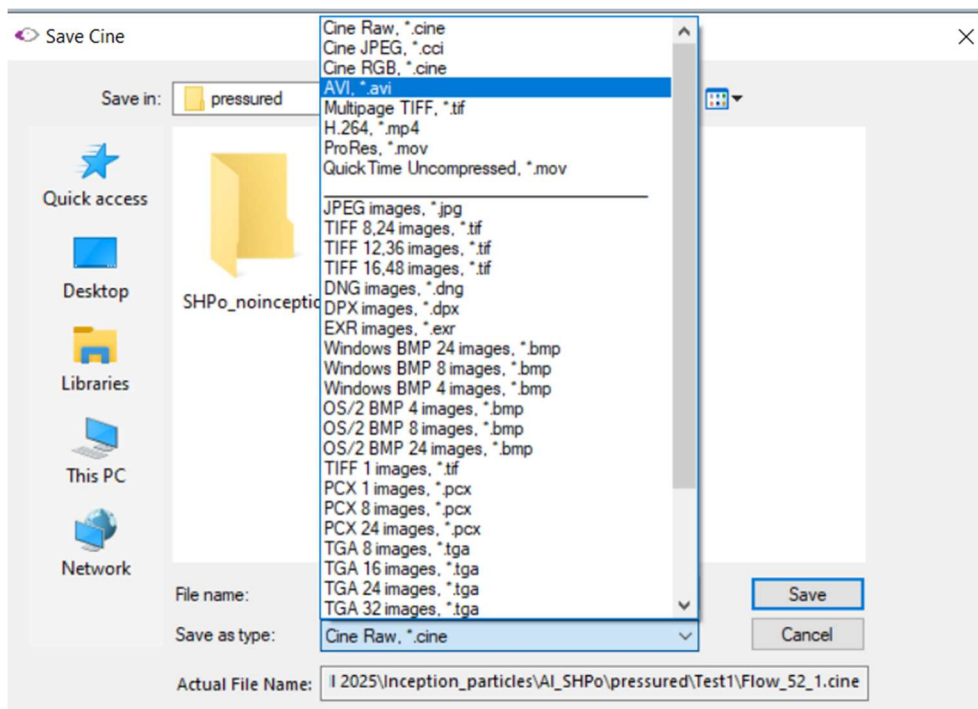# HOW TO USE ARC FOR OPTICAL FLOW ANALYSIS (USING MATLAB)
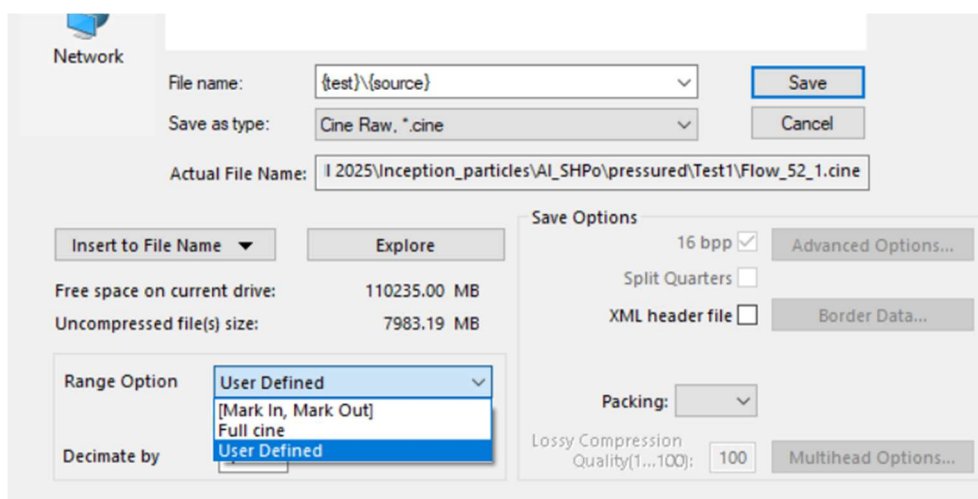
- SWATHIGA DEVI CHANDRASEKARAN

STEP 1 - VIDEOS

1) Save all the videos from phantom camera software as .avi file. You can open the saved cine file in camera software, choose Save as (.avi) file.

2) You can manually alter the number of frames to be saved.

Great! You have the right video format.

STEP 2 – MATLAB CODE

To run the analysis, make sure to have all these MATLAB codes and the script for ARC.

raftmatlabsideview_sanjay	13-11-2025 15:38	MATLAB Code	18 KB
ROI_and_throatloader	13-11-2025 15:38	MATLAB Code	3 KB
testraft	13-11-2025 15:38	Shell Script	2 KB
timeaveragedvelmagnitude	13-11-2025 15:38	MATLAB Code	8 KB
Velocity_profile_comparison	18-11-2025 11:41	MATLAB Code	8 KB

Run this code - ROI and throatloader code ???

- You can run this code in MATLAB (laptop/computer, not ARC).
- When you run this code, it will ask you to select a video file.
- Select the .avi file you want to analyze.
- Now, the interactive session will ask you to select the Region of Interest (ROI). Select the region you wish to analyze (ex: Neglecting Venturi). Double-tap.
- Now, it will ask you to select the throat. Mark the throat, press Enter.
- Two .mat files will be saved in the same folder as the input file.

Cool! You have ROI and throat data.

STEP 3 – WHAT IS ARC? HOW TO USE IT?

Using MATLAB on your laptop works, but it takes so much time to process. To make the process quicker, we are using ARC (Advanced Research Computing) VT. To access ARC VT

1) You need to create an account using your VT email ID. Also, the Professor should add you to the cavitation project in ARC. Once your account is created, you will get an email like this →

Advanced Research Computing Account Created ⊞ Summarize

Your account on the ARC clusters has been created. Please follow the instructions below. You can review the ARC documentation website for additional information. If you have any issues please open a ticket at 4Help or drop by office hours.

1. Setting up VT VPN when off-campus:

You need to establish a VPN connection when off-campus to access the clusters. Information on installing and using the VT VPN is available on the VT VPN website.

2. Accessing the clusters:

Option 1) Web interface via Open OnDemand:

Go to https://ood.arc.vt.edu to access the clusters through a web interface providing a graphical user interface for the most commonly used applications including Matlab, RStudio, Sage, Jupyter, VS Code.

Option 2) SSH and SFTP access:

Access to the clusters is facilitated through Secure Shell (SSH) and Secure File Transfer (SFTP) clients. Windows, MacOS, and Linux users can utilize these commands via their terminal. You may also use FileZilla for SFTP file transfers.

Connect to the clusters using your VT username and password. For command-line SSH clients, log in with:

ssh yourVTusername@clusterLoginNode

| Cluster	Login Nodes (use any)
TinkerCliffs	tinkercliffs1.arc.vt.edu or tinkercliffs2.arc.vt.edu
Owl	owl1.arc.vt.edu or owl2.arc.vt.edu or owl3.arc.vt.edu
Falcon	falcon1.arc.vt.edu or falcon2.arc.vt.edu

2) ARC cannot be accessed without VPN outside the campus. So, if you intend to use it off campus, download VT VPN (Ivanti), as mentioned in the email.

3) To access the clusters (ARC), use https://ood.arc.vt.edu. When you go to this link, you will see this →
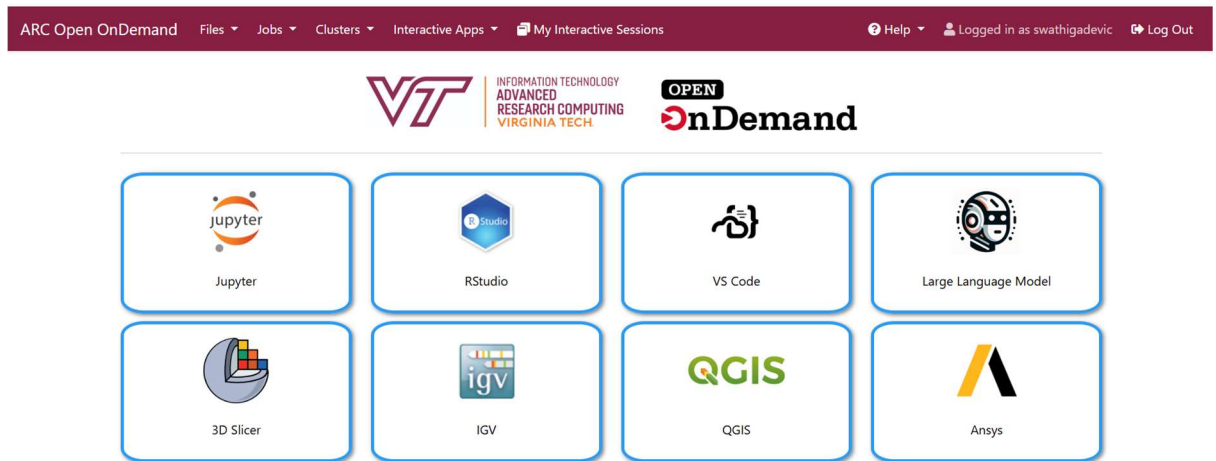
4) You will have your own directory with your name once the account is created. Click Files to see the documents in your directory. You can upload and download the files you want to work with in your directory.
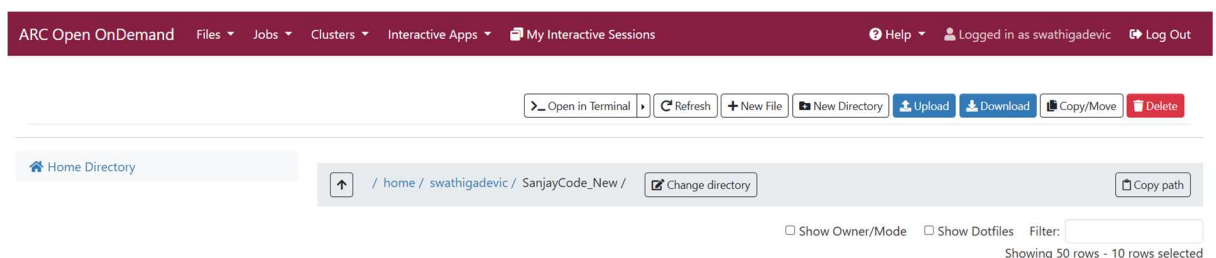
STEP 4 – USING ARC FOR OUR ANALYSIS

1) Upload these code files to your directory. These are common for all test runs.

raftmatlabsideview_sanjay	13-11-2025 15:38	MATLAB Code	18 KB
testraft	13-11-2025 15:38	Shell Script	2 KB
timeaveragedvelmagnitude	13-11-2025 15:38	MATLAB Code	8 KB
Velocity_profile_comparison	18-11-2025 11:41	MATLAB Code	8 KB

2) Upload the video (.avi file) to be analyzed in ARC

3) Also, upload the output .mat files from the ROI and throatloader code for each case.
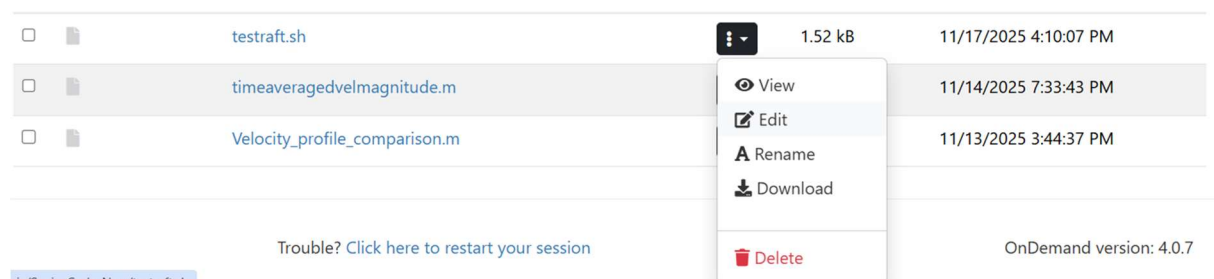   **Example**: For a video file named: Al_noinception.avi. The ROI and throat data would look like this →

📄 AI_noinception_ROI		16-11-2025 15:33	MATLAB Data		5 KB
📄 AI_noinception_throat		16-11-2025 15:33	MATLAB Data		1 KB

4) Now, you have the ROI data, throat location data, and the MATLAB codes to run on the ARC.

WHAT TO BE MODIFIED FOR EACH TEST CASE?

1) **testraft.sh**

This is a script given to the ARC to run the job. For each test case, the file name should be modified. To edit the file, choose the three dots, click edit.

☐ 📄	testraft.sh		⋮▾	1.52 kB	11/17/2025 4:10:07 PM
☐ 📄	timeaveragedvelmagnitude.m		👁 View		11/14/2025 7:33:43 PM
☐ 📄	Velocity_profile_comparison.m		✏ Edit		11/13/2025 3:44:37 PM
			A Rename		
	Trouble? Click here to restart your session		⬇ Download		OnDemand version: 4.0.7
vic/SanjayCode_New/testraft.sh			🗑 Delete		

In here,
➔ Change the email ID (**Line 13**) to yours. This will notify you about the start and end of each job.

```
1   #!/bin/bash
2   #SBATCH --output=RAFT_SideView_%j.out
3   #SBATCH --error=RAFT_SideView_%j.err
4   #SBATCH --time=08:00:00
5   #SBATCH --account=cavitation
6   #SBATCH --nodes=1
7   #SBATCH --ntasks=1
8   #SBATCH --cpus-per-task=48
9   #SBATCH --gres=gpu:2
10  #SBATCH --mem=380G
11  #SBATCH --partition=l40s_normal_q
12  #SBATCH --mail-type=BEGIN,END,FAIL
13  #SBATCH --mail-user=swathigadevic@vt.edu
14  #SBATCH --job-name=Cavitation
15
16  module reset
17  module load MATLAB
```

➔ Change the directory (**Line 35**)

```
22  echo "============================================================"
23  echo " SLURM Job ID:        $SLURM_JOB_ID"
24  echo " Node:                $HOSTNAME"
25  echo " Submitted from:      $SLURM_SUBMIT_DIR"
26  echo " Start time:          $(date)"
27  echo "============================================================"
28
29  # GPU monitoring (every 300 seconds)
30  nvidia-smi --query-gpu=timestamp,name,pci.bus_id,driver_version,temperature.gpu,utilization.gpu,utilization.memory,memory
31
32  # ----------------------------------------------------------------
33  # Launch MATLAB (non-interactive batch mode)
34  # ----------------------------------------------------------------
35  matlab -nodisplay -nosplash -nodesktop -batch "run('/home/swathigadevic/SanjayCode_New/raftmatlabsideview_sanjay.m')"
```

➔ Save it.

2) raftmatlabsideview_sanjay

Similarly, edit this code as well.
➔ Change the file path (**Line 21**)

```
1   %% ----------------------------------------------------------
2   % Optical Flow RAFT + ROI (roipoly) + Calibrated Velocity in m/s
3   % Time-averaged velocity + vertical profiles with axes in mm (origin at lower-left)
4   % ----------------------------------------------------------
5   clear all; clc; close all;
6
7   % --- Load your personal toolbox path safely ---
8   userPathFile = fullfile(getenv('HOME'), 'matlab', 'pathdef.m');
9   if isfile(userPathFile)
10      addpath(genpath(fileparts(userPathFile)));  % add folder containing pathdef.m
11      run(userPathFile);                          % execute your saved pathdef.m
12      fprintf('Loaded custom MATLAB path: %s\n', userPathFile);
13  else
14      warning('Custom pathdef.m not found. Using default MATLAB path.');
15  end
16
17
18
19  try
20      %% --- Specify video path ---
21      videoPath = '/home/swathigadevic/SanjayCode_New/CB_noinception.avi';  % <-- Adjust if needed
22      [filepath, filename, ~] = fileparts(char(videoPath));
23
24      if ~isfile(videoPath)
25          error('Video file not found at: %s', videoPath);
26      end
27
28      v = VideoReader(videoPath);
29      fprintf('Loaded video: %s\n', filename);
```

➔ Change the mm/pixel (Line 32) and fps (Line 33), if needed (Based on your case)

```
27
28      v = VideoReader(videoPath);
29      fprintf('Loaded video: %s\n', filename);
30
31      %% --- Calibration parameters ---
32      mm_per_pixel = 0.00388514345;   % [mm/pixel]
33      fps          = 110000;          % [frames per second]
34      m_per_pixel  = mm_per_pixel / 1000;  % [m/pixel]
35      fprintf('Calibration: %.9f m/pixel | Frame rate: %.1f fps\n', m_per_pixel, fps);
36
37      %% ----------------------------------------------------------
38      % Load existing ROI mask if available, else select and save a new one
39      % ----------------------------------------------------------
40      fprintf('Checking for existing ROI...\n');
41      roiFile = fullfile(filepath, [filename '_ROI.mat']);  % Default ROI filename
42
```
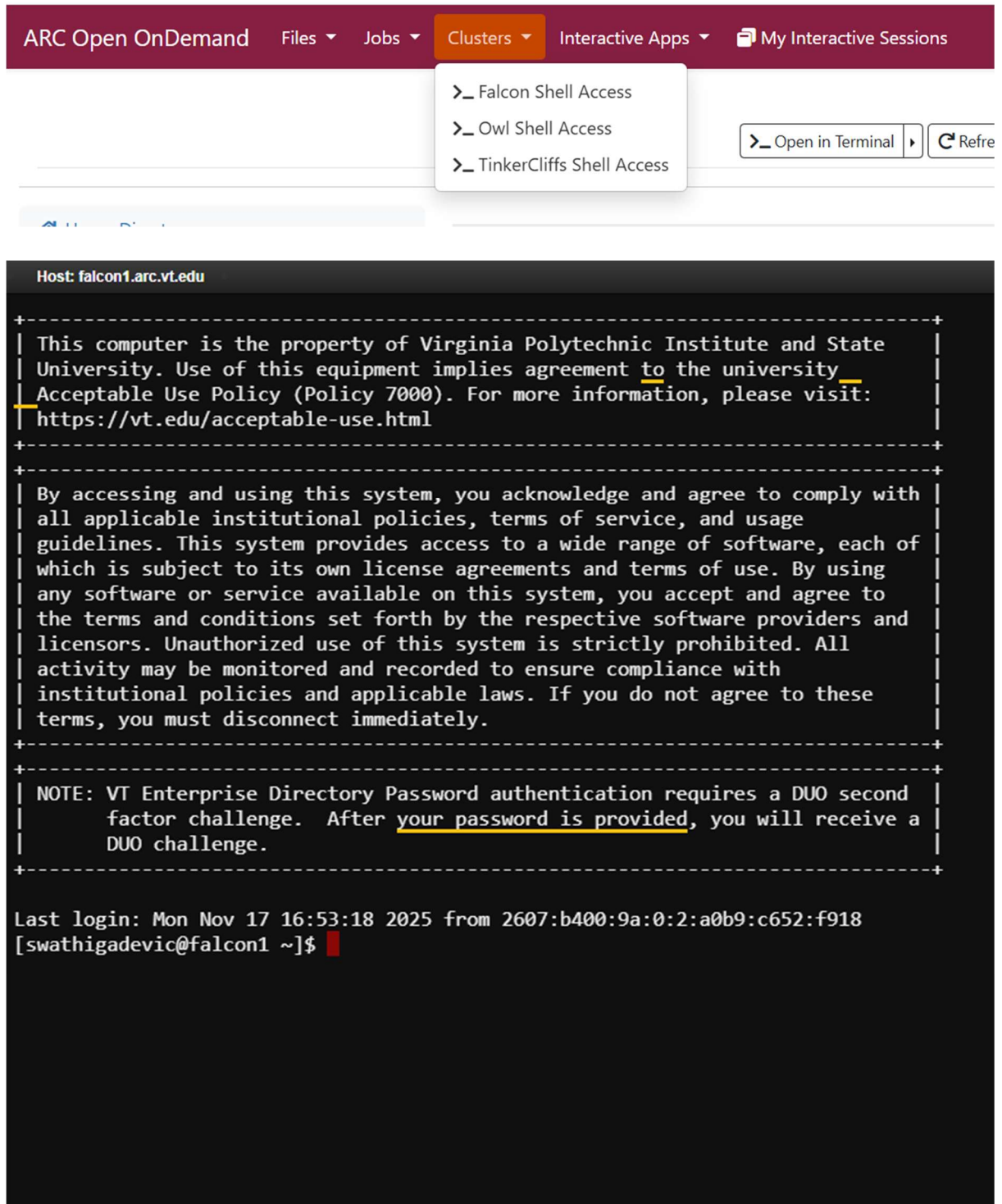
➔ Save it.

All set for analysis now!

STEP 5 – SUBMITTING A JOB IN ARC

1) To run the analysis, click Clusters → Falcon Shell Access.

This will show your directory (/home/yourname). Make sure your videos and codes are in this directory.

→ Type **sbatch testraft.sh**, click enter

```
+----------------------------------------------------------------+
| NOTE: VT Enterprise Directory Password authentication requires a DUO second |
|       factor challenge.  After your password is provided, you will receive a |
|       DUO challenge.                                           |
+----------------------------------------------------------------+

Last login: Mon Nov 17 16:53:18 2025 from 2607:b400:9a:0:2:a0b9:c652:f918
[swathigadevic@falcon1 ~]$ sbatch testraft.sh
```

→It will show submitted batch job, if successful. You will get an email once the job starts.

```
Submitted batch job 124194
```

→To check the status of the job, type **squeue** (After successful submission)

```
 JOBID PARTITION     NAME     USER ST       TIME  NODES NODELIST(REASON)
 124194 l40s_norm Cavitati swathiga PD       0:00      1 (Priority)
```

→ ST – **PD means Pending**, hasn't started yet
→ ST – **R means Running**. You will see the time taken for each analysis.
→ Once the job is completed, you will receive an email stating "job ended".
→ To cancel a job, type **scancel "JOB ID"**

```
scancel 124194
```

STEP 6 – OUTPUTS??

☐	🗋	AI_noinception_ThroatProfiles.mat	⋮ ▾	703.58 MB
☐	🗋	AI_noinception_TimeAvgVelField.mat	⋮ ▾	2.90 MB
☐	🗋	AI_noinception_TimeAvgVelMag.png	⋮ ▾	56.69 kB
☐	🗋	AI_noinception_VelField_200to300.gif	⋮ ▾	2.68 MB
☐	🗋	AI_noinception_velocity.mat	⋮ ▾	49.93 GB
☐	🗋	AI_noinception_VelProfiles.png	⋮ ▾	66.68 kB

You will be able to see (for reference)
➔ Time-averaged velocity magnitude plot (.png file) for your case
➔ Velocity field for 200-300 frames (gif file)
➔ Velocity profiles (.png)

For further analysis across all frames, you can use →

1) ThroatProfiles.mat – You can download this .mat file and run it on your laptop/computer. This gives you the velocity profiles at respective locations from the throat.

➔ Run the data in this code – **Velocity_profile_comparison**

➔ Modify the file directory in the code

2) Velocity.mat – Gives the instantaneous velocity values across all frames (Huge file). **_Code to be written to use this data_**

SUMMARY

For each video (case):

1) Get the video (.avi file)
2) Get ROI and throat MATLAB .mat file (**Using ROI_and_throatloader code**)
3) Upload all the files in ARC (respective case) – Video, ROI & THROAT
4) **Edit testraft.sh and raftmatlabsideview_sanjay in ARC**
5) Submit job in Falcon
6) Obtain velocity data and plots in ARC
7) Download .mat files for further analysis in matlab using **velocity_profile_comparison code**

FOR QUERIES:

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