SurfZoneFun v1.0 User Guide
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Tom Shand & Pete Quilter

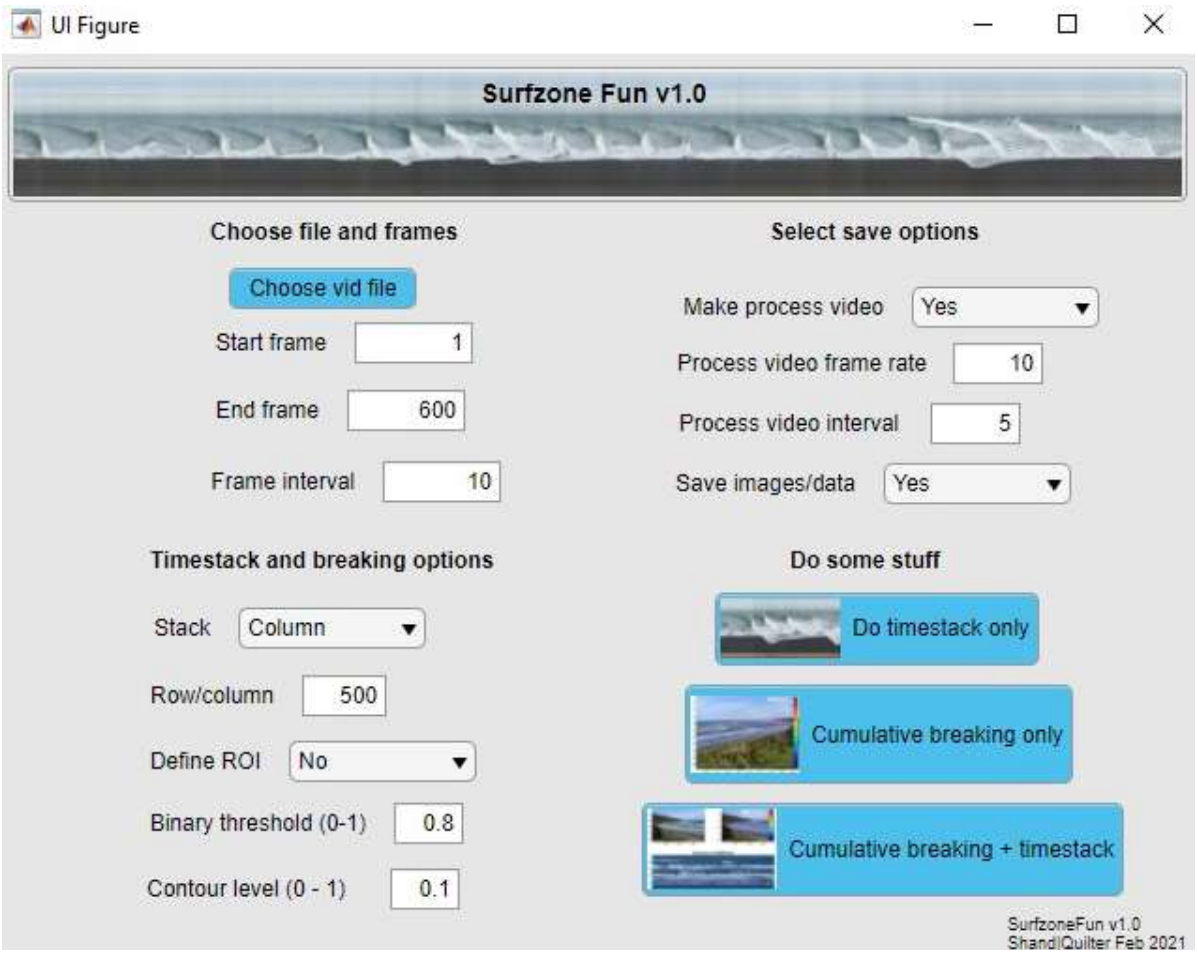
SurfzoneFun processes videos to illustrate surf zone processes. The main functions of the package include:

1. Progressively average video frames
2. Create a timestack of a single profile of pixels
3. Identify breaking portion of an image using a threshold and sum over time to give precent exceedance

The intent of this package is to provide outputs that will be useful for future analysis but also to visually illustrate the averaging, stacking and breaking processing.

There are a number of different ways of running SurfZoneFun:

1. Install the matlab app ***SurfZoneFunGUIv1.0.mlappinstall.*** The GUI can be run straight from the apps tab in your matlab
2. Run ***SurfZoneFunGUI.m*** which will open the GUI
3. Open ***SurfZoneFun.m*** and specify your location, file and values and hit run
4. Run the examples with pre-specified versions of SurfZoneFun, i.e. ***run_Example1.m***
5. Call the individual processing engines (***BinaryEngine.m, TimestackEngine.m, TimestackBinaryEngine.m***)– if you want to batch run multiple videos you can do it this way.



Variable	Description
File and frames	
File	Video file for processing
Start frame	First frame of the video to use
End frame	Last frame of the video to use – use 9999 to use last frame
Frame interval	Frame interval relative to video frame rate (i.e. using 3 on a 30fps video will result in 10 fps)
Timestack and breaking options	
Stack	Select column, row, user defined (image will open and user selects path will be used and saved as stackxy.mat) or pre-defined where stackxy.mat is loaded from same directory as the selected video file
Row/column	Row or column to be stacked (from top/left)
Define ROI	No, Yes (where image will open and user selects ROI for breaking analysis to be done within and saved as mask.mat), pre-defined where mask.mat is loaded from same directory as the selected video file
Binary threshold	0 – 1 threshold value for breaking analysis. Default = 0.8
Contour level	0 – 1 exceedance contour for breaking waves (default = 0.1 = 10% exceedance)
Save options	
Make process video	Do you want to save a video of the progressive processing
Process video frame rate	What frame rate should the process video be played at (default 10). This will be a function of the raw video frame rate and frame interval
Process video interval	Save every x frames in video – useful where you have >~2000 frames and you can run out of memory saving every one
Save images/data	Do you want to saves images and data (see outputs below)
Do some stuff	
Timestack only	Do image average and timestack only
Cumulative breaking only	Do image average and cumulative breaking only
Cumulative breaking + timestack	Do image average, timestack and cumulative breaking

Output	Description	Output		
		Timestack only	**Cumulative breaking**	**Cum break + stack**
*filename*_average.jpg	Time-averaged image	x	x	x
filename _stack.jpg	Timestack image (raw)	x		x
filename _stack.mat	Timestack data	x		x
filename _timestack.jpg	Timestack image with axes	x		x
filename _binarysum.jpg	Sum of the frame-by-frame binary threshold figure		x	x
filename _binarysum.mat	Binary sum data		x	x
filename _10-contour.mat	10% exceedance contour data		x	x
filename _breakingexceedance.jpg	Binary sum with contour overlaid		x	x
filename _processfigure.jpg	Figure showing the process video on the last frame	x	x	x
filename _processvideo.avi	Process video	x	x	x

Software requirements:
Matlab (tested on R2018b), Image processing toolbox

Known bugs:
- Can run out of memory if you are trying to process too many frames (or more often save a process video with too many frames)
- If you stack a row it will pull out the profile left to right – so if you're looking north it can give a back-to-front stack
- Threshold still needs a bit of trial and error and isn't great with varying exposure during the video, shadowing, etc.

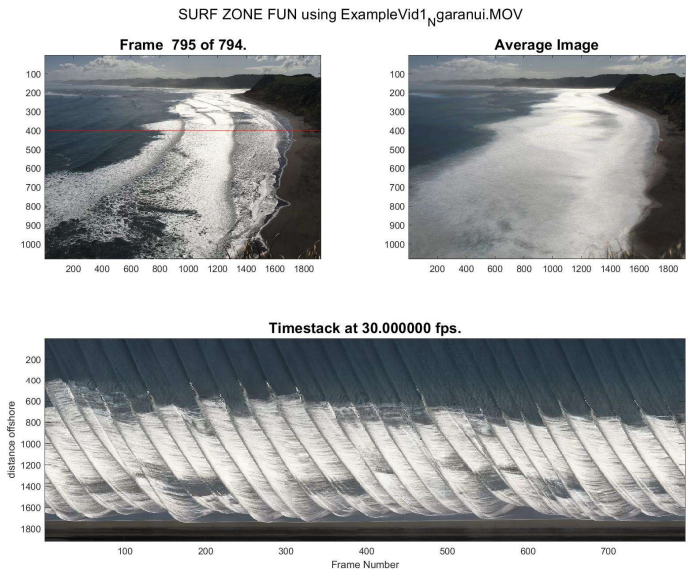
To-dos for future versions
1. Add a variable or dynamic threshold for breaking waves
2. Add an option to rectify output images (at the moment you can do separately using g_rect or similar)
3. Add an option to register video to remove movement between frames
4. Incorporate wmeasure to assess breaking wave height (from Shand et al 2012)

Contact:
Dr Tom Shand
Department of Civil and Environmental Engineering, The University of Auckland
t.shand@auckland.ac.nz | t.d.shand@gmail.com

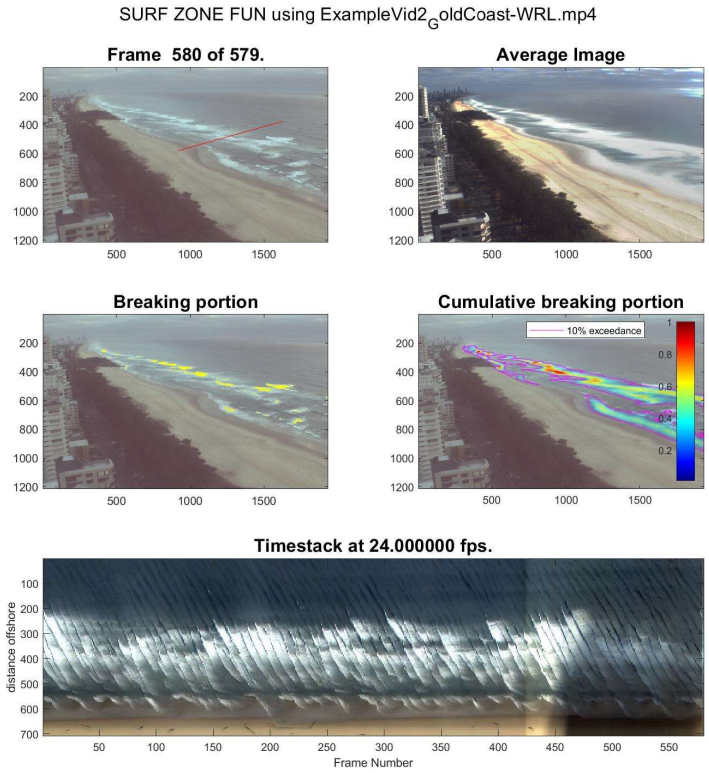
References
Shand, T., Bailey, D., Shand, R. (2011) Automated Detection of Breaking Wave Height Using an Optical Technique. J. Coast. Res.2012,28, 671–682.

Shand, T., Weppe, S., Quilter, P., Short, A., Blumberg, B and Reinen-Hamill, R. (2020) Assessing the Effect Of Earthquake-Induced Uplift And Engineering Works on a Surf Break of National Significance. Coastal Engineering Proceedings

Examples
ExampleVid1_Ngaranui.MOV
Timelapse video of Ngaranui Beach by Tom Shand (2020)
Run from GUI or ***run_Example1.m***



ExampleVid2_GoldCoast-WRL.mp4
Timelapse video of Palm Beach by the Water Research Laboratory (2020)
Run from GUI or ***run_Example2.m***



ExampleVid3_MangamaunuRect.avi
Rectified timelapse video of Mangamaunu Point, see Shand et al., (2020)
Run from GUI or ***run_Example3.m***