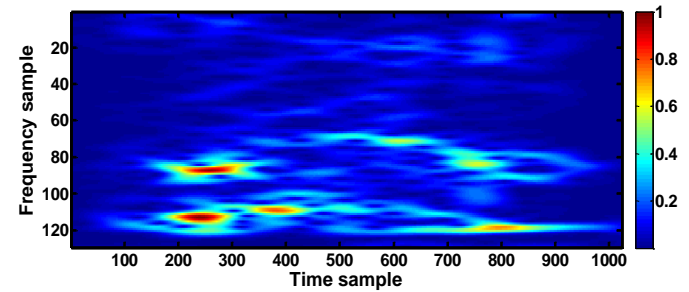
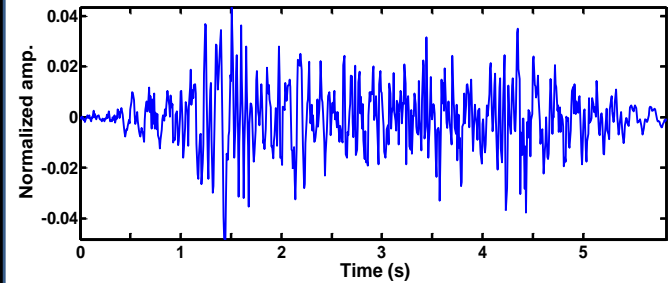
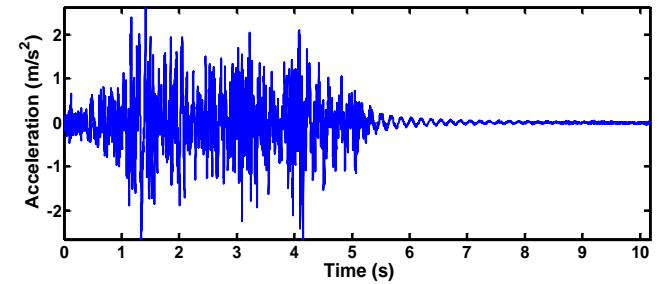


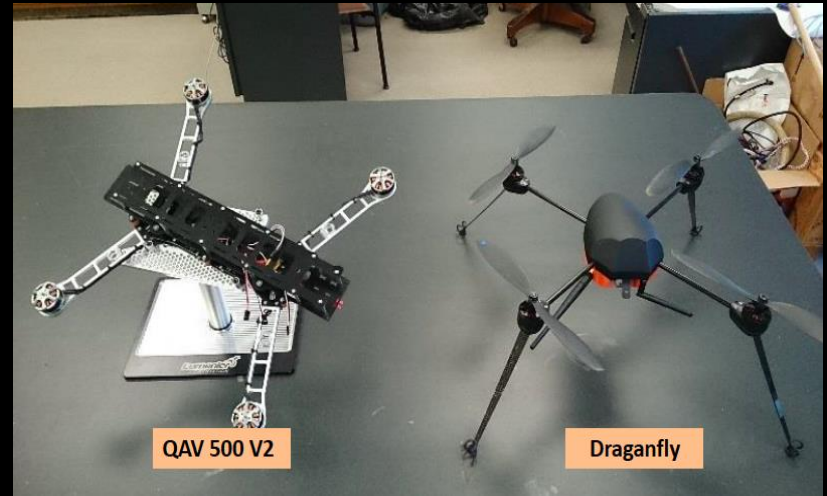
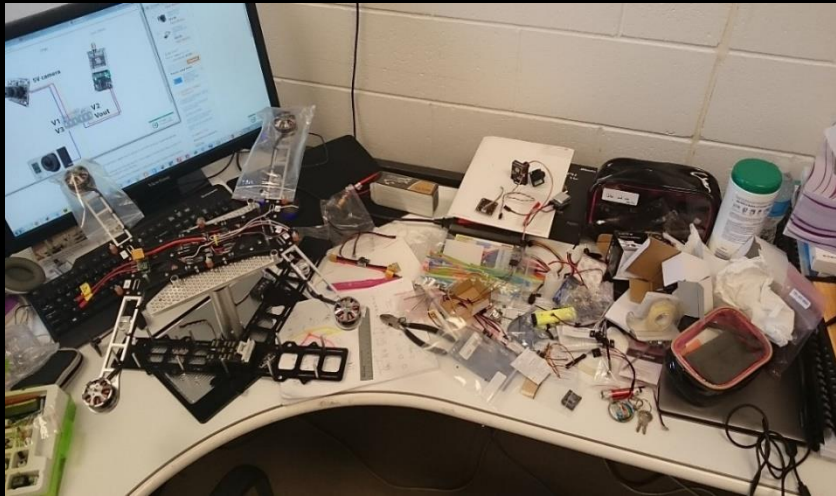
# What Does the Image Tell You ?

**Chul Min Yeum**

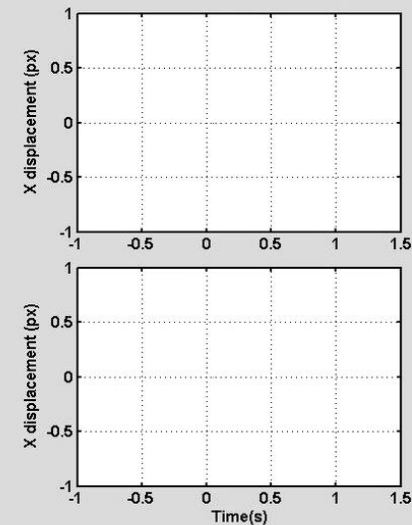
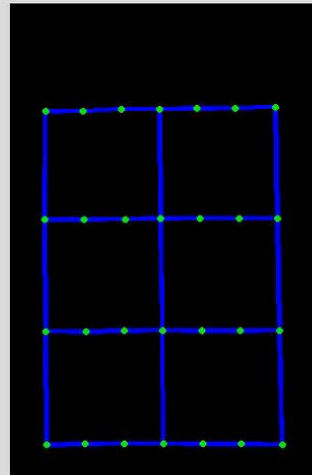
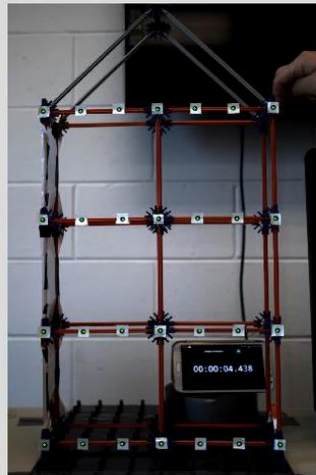
**Department of Civil Engineering  
Purdue University**



# Vehicle detection on a mobile bridge



## Build unmanned Aerial Vehicles



## Vision based vibration measurement

# My research is



**What Does the Image Tell You ?**



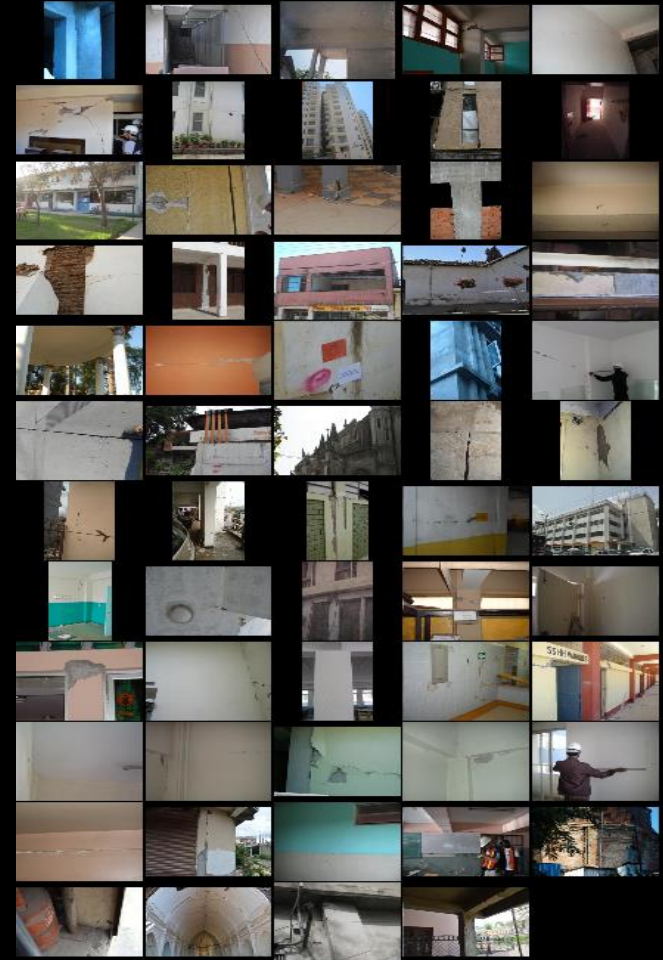


# Nepal Earthquake, 2015





# What if ?







Large-scale images

Autonomous  
analysis

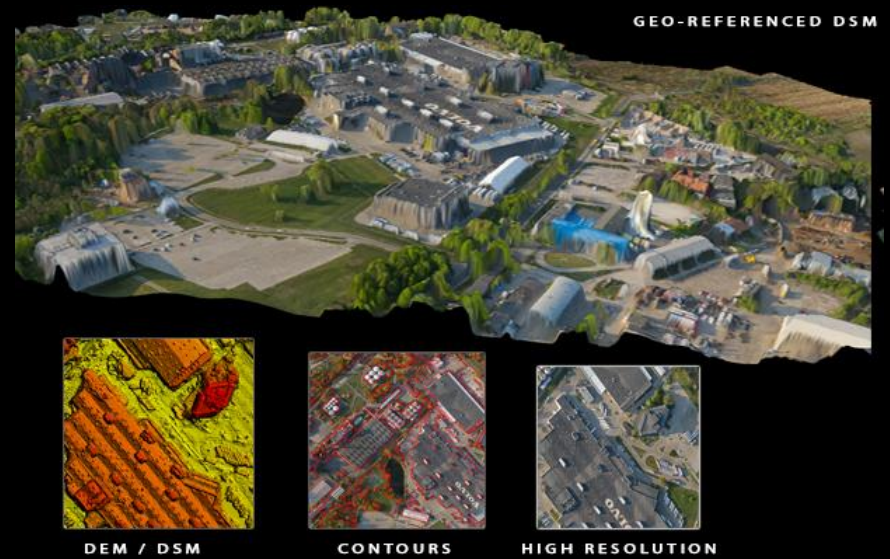


Damage? Undamage?

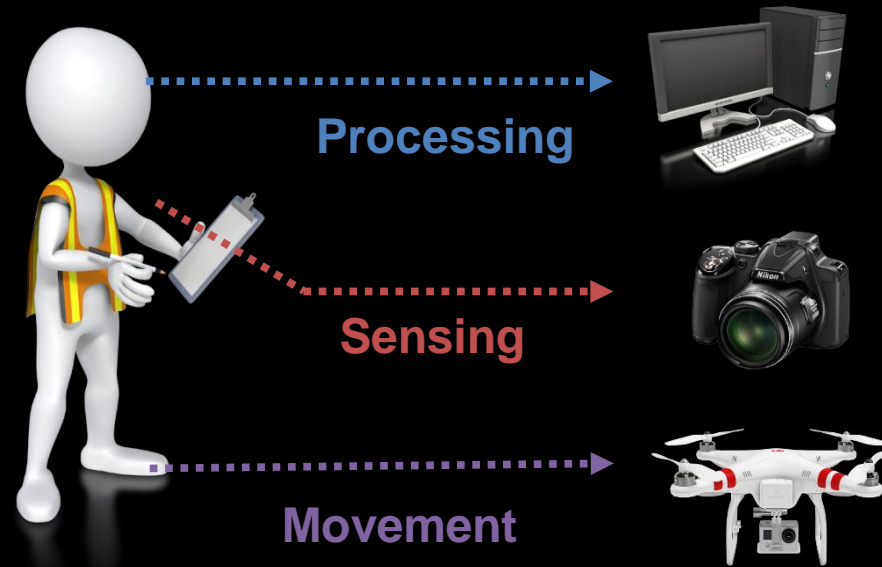
Support decision-making



**Search & Rescue**



**Mapping or 3D point cloud**



# Structural inspection



**Building damage**



**Bridge collapse**



**Road damage**





# Challenges

# Collected Images from a Disaster

Irrelevant

Relevant

Unorganized and complex images





They are dogs.  
But I don't  
know why !!!

Difficult to describe our object





D:\Images - WinDirStat

File Edit Clean Up Treemap Report Options Help

Name	Extension	Color	Description	> Bytes	% Bytes	Files
D:\Images						
[Fierro][EQ][Haiti][2010][P]	.jpg		JPEG Image	156.6 GB	98.6%	67,144
[EER][EQ][Nepal Nepal][2015][U][none][Clearinghou:]	.nef		NEF File	2.1 GB	1.3%	211
[Dhub][EQ][Nepal][2015][P]	.png		PNG Image	144.2 MB	0.1%	130
[Fierro][EQ][Peru][2007][P]	.pdf		Adobe Acrobat Document	26.7 MB	0.0%	115
[EER][EQ][Nevada USA][2014][U][none][Clearinghou:]	.avi		GOM Media file(.avi)	20.0 MB	0.0%	1
[FEMA][TN][2011][P][TOM]	.db		Data Base File	14.5 MB	0.0%	81
[FEMA][HR][Texas][2008][P][Ike][TOM]	.dwg		DWG File	7.0 MB	0.0%	73
[FEMA][HR][Florida][2004][P][Ivan][TOM]	.html		Chrome HTML Document	5.5 MB	0.0%	819
[FEMA][HR][Florida][2004][P][Charley][TOM]	.xls		Microsoft Excel 97-2003 Wor...	4.9 MB	0.0%	53
[Dhub][EQ][Peru][2007][P]	.ds_store		DS_STORE File	2.1 MB	0.0%	302
[Dhub][EQ][Mexico][1985][P][none][Soze_SlideScan]	.bak		BAK File	377.8 KB	0.0%	6
[Dhub][EQ][Sendai][1978][P][none][Soze_SlideScan]	.xlsx		Microsoft Excel Worksheet	133.7 KB	0.0%	13
[Dhub][EQ][Nepal][2015][P][ID_17336][HighRise]	.txt		TXT File	7.0 KB	0.0%	227
[FEMA][TN][Greensburg][2007][P][TOM]	.m		MATLAB Code	2.5 KB	0.0%	2
[Dhub][EQ][Nepal][2015][P][ID_17338][HighRise]	.url		Internet Shortcut	370 Byt...	0.0%	3
	.log		Text Document	334 Byt...	0.0%	1
	.ini		Configuration settings	101 Byt...	0.0%	1

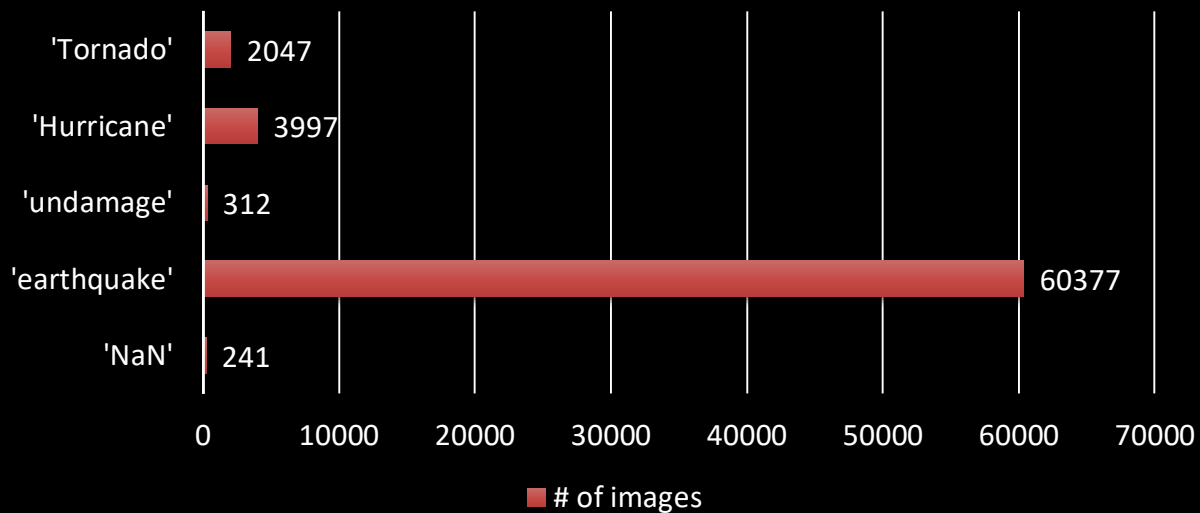
  

Extension	Color	Description	> Bytes	% Bytes	Files
.jpg		JPEG Image	156.6 GB	98.6%	67,144
.nef		NEF File	2.1 GB	1.3%	211
.png		PNG Image	144.2 MB	0.1%	130
.pdf		Adobe Acrobat Document	26.7 MB	0.0%	115

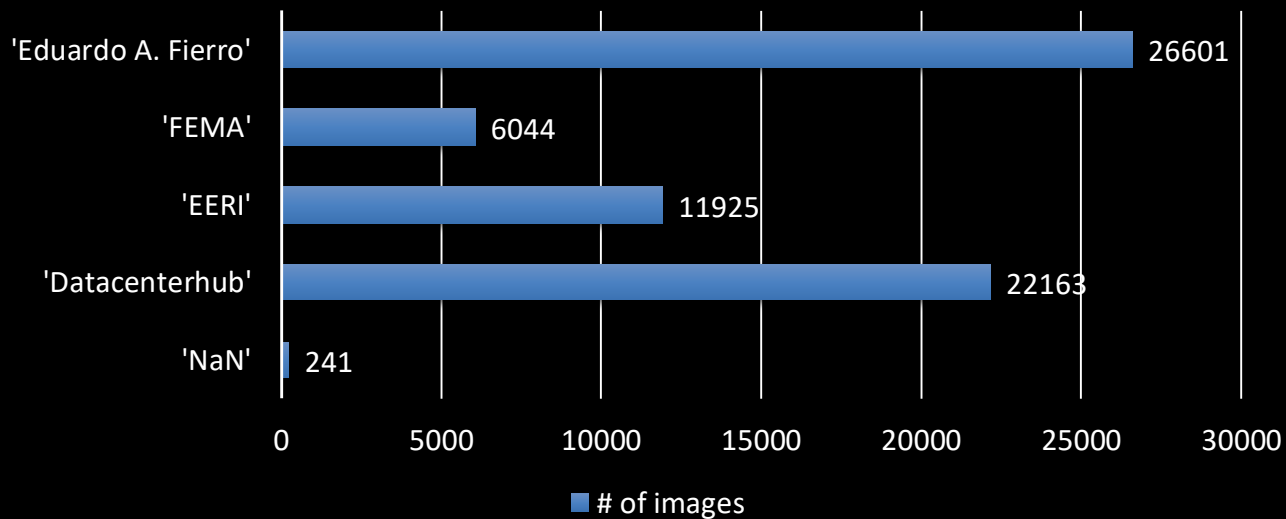
Ready RAM Usage: 29.7 MB NUM

# 67,000 Images

## Disaster



## Data source



# Why Do I Need Many Images ?







- Four legs
- Four corner
- Flat top areas
- ...



Table



# Large-scale Image data



...



Table



# Deep Neural Network

**Big images  
data**



**Training  
parameters**



**Ground truth  
(labels)**

60 million parameters  
650,000 neurons



**Table**



# Collapse

an instance of a structure falling down or in.



# Spalling

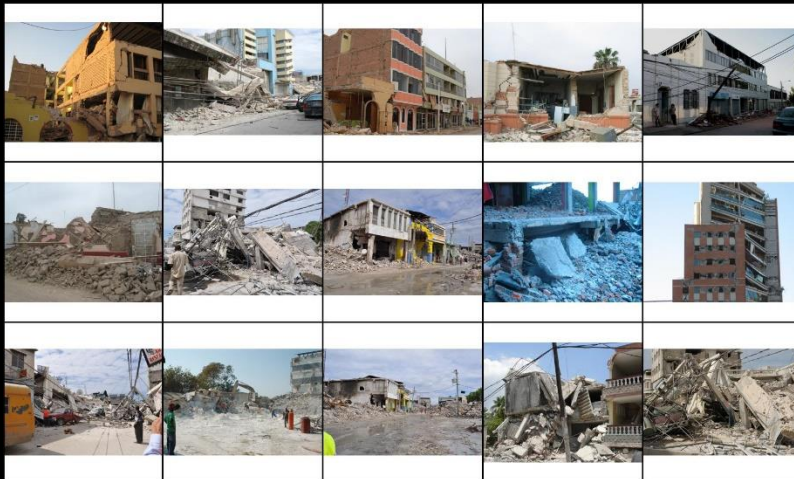
Break off in fragments



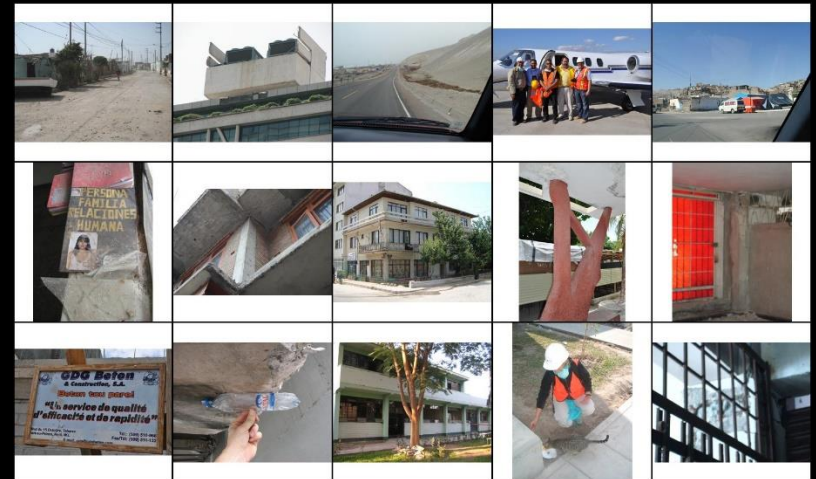
Image annotation among 67,000



Spalling annotation: 1,918 images



Collapse (**Positive**): 1,918 images



Non-collapse (**Negative**) : 3,427 images





Non-collapse(X)



Collapse(O)



Non-collapse(O)



Non-collapse(O)



Non-collapse(O)



Non-collapse(O)



Non-collapse(O)



Non-collapse(O)



Non-collapse(O)



Non-collapse(O)



Non-collapse(O)



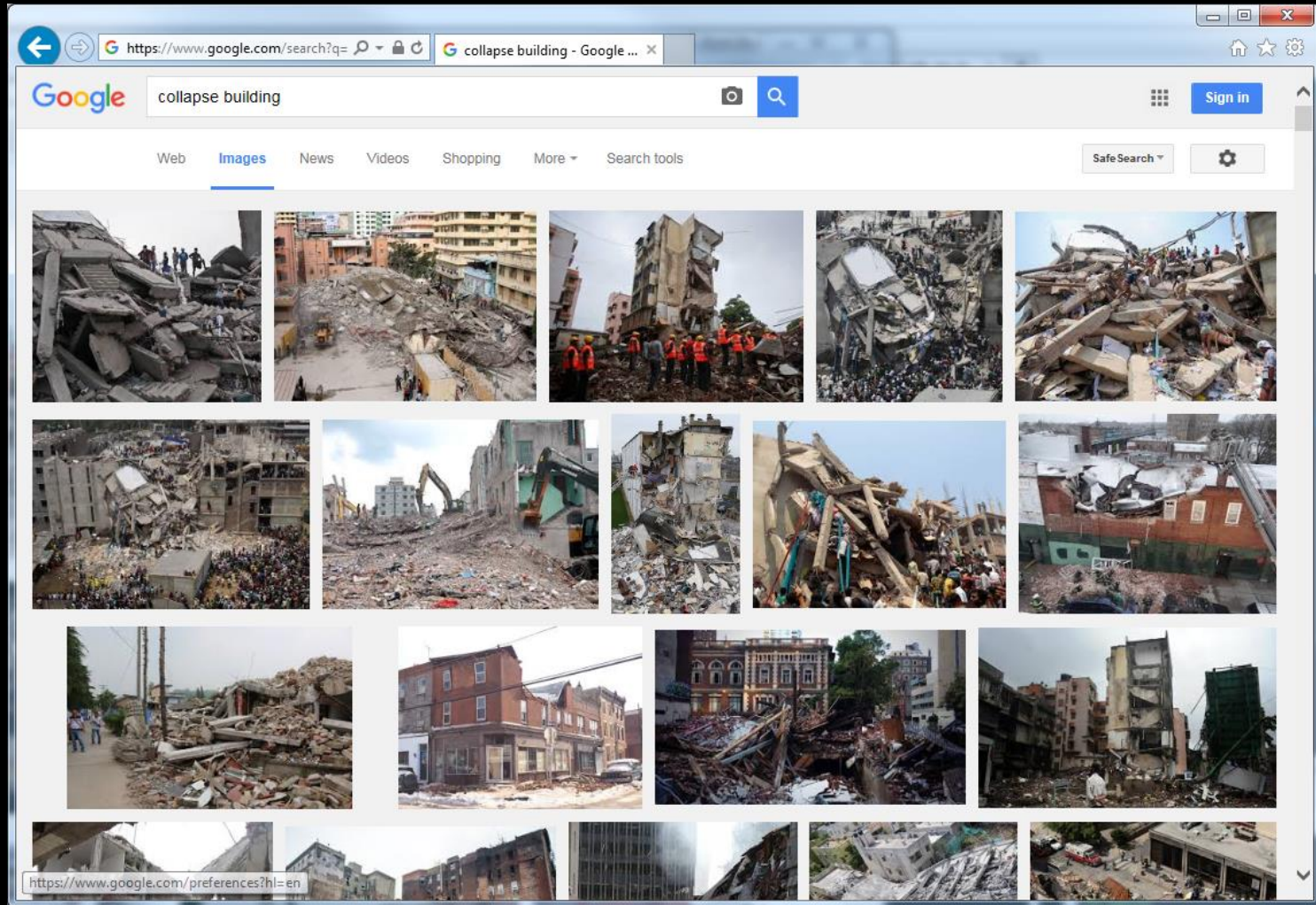
Collapse(O)

**Collapse Detection: 91 % Precision**





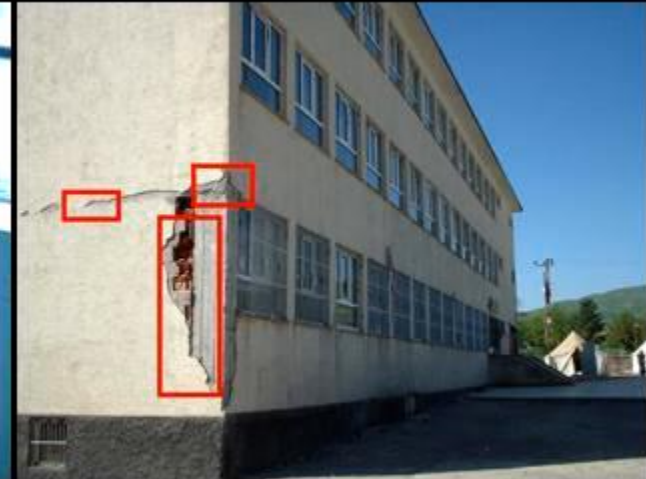
collapse building







**Collapse Detection: 78 % Precision**



**Spalling Detection on Spalling Images**





**Spalling Detection on Undamage Images**



**Future Study**

**Thank You**