

Locating Seismic-Sense Stations Through Genetic Algorithm

Josafath Israel Espinosa Ramos

Roberto A. Vázquez

Intelligent Systems Group

Facultad de Ingeniería - Universidad La Salle

México, D.F.



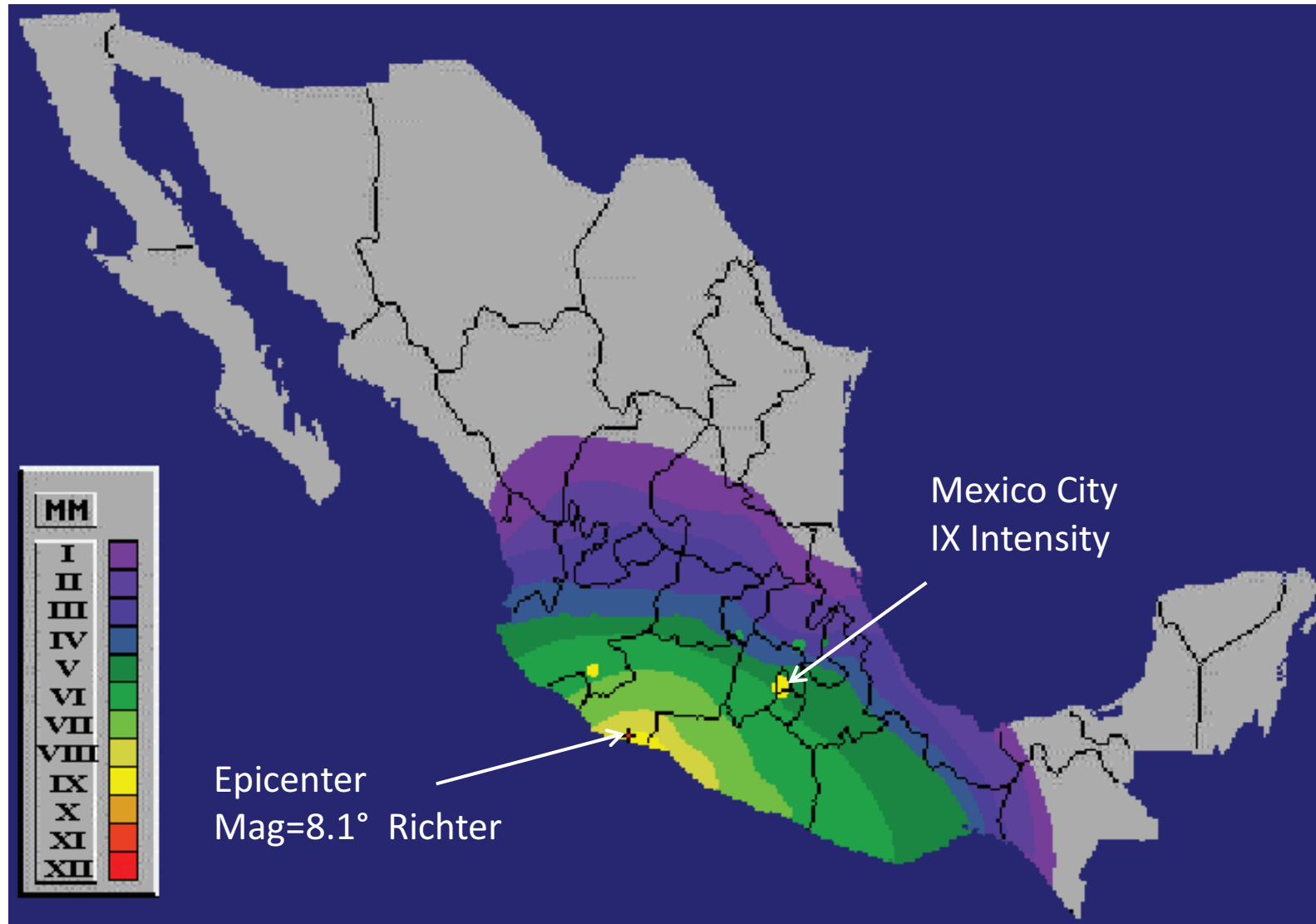
Universidad La Salle

Locating Seismic-Sense Stations Through Genetic Algorithm Problem





Locating Seismic-Sense Stations Through Genetic Algorithm Problem





- Seismic silence between Acapulco and Zihuatanejo.
- Possibility of an earthquake likes the one in 1985 in México City.



Locating Seismic-Sense Stations Through Genetic Algorithm Statistics

DATE	REGION	MAGNITUDE	HUMAN LOST
January 26, 1531	Lisboa, Portugal	Not recorded	30 000
January 23, 1556	Shensi, China	..	830 000
November 1, 1667	Shemaka, Cáucaso	..	80 000
January 11, 1693	Catania, Italy	..	60 000
October 11, 1737	Calcuta, India	..	30 000
June 7, 1755	North of Persia	..	40 000
November 1, 1755	Lisboa, Portugal	..	70 000
February 1, 1783	Calabria, Italy	..	50 000
February 4, 1797	Quito, Ecuador	..	40 000
September 5, 1822	Aleppo, Asia Alenor	..	22 000
December 18, 1828	Echigo, Japan	..	30 000
August 12, 1868	Perú and Bolivia	..	25 000
August 15, 1868	Ecuador and Colombia	..	70 000
December 16, 1920	Kansu, China	8.5	180 000
September 1, 1923	Kwato, Japan	8.2	143 000
December 26, 1932	Kansu, China	7.6	70 000
June 15, 1896	Riku-Ugo, Japan		22 000
December 28, 1908	Mesina, Italy	7.5	120 000



Locating Seismic-Sense Stations Through Genetic Algorithm Statistics

DATE	REGION	MAGNITUDE	HUMAN LOST
January 13, 1915	Avezzano, Italy	7	30 000
December 16, 1920	Kansu, China	7.5	70 000
May 31, 1935	Queta, India	7.5	60 000
January 24, 1939	Chile	7.7	30 000
December 27, 1939	Erzincan, Turquía	8	23 000
February 29, 1960	Agadir, Morocco	5.9	14 000
September 1, 1962	Iran	7.3	14 000
August 31, 1968	Iran	7.4	11 000
May 31, 1970	Perú	7.8	66 000
December 23, 1972	Managua, Nicaragua	6.2	5 000
February 4, 1976	Guatemala	7.9	22 000-23 000
July 27, 1976	Tang Shan, China	7.6	655 000
August 16, 1976	Mindanao, Filipinas	7.9	7 900
November 24, 1976	Irán	7.3	5 000-8 000
October 12, 1976	El Asnam, Argelia	7.3	5 000
September 19, 1985	Mexico City	8.1	5 000
January 10, 2010	Haití	7	200 000



Locating Seismic-Sense Stations Through Genetic Algorithm

Objective

To optimize a seismic network to warn the population of an impending earthquake.



Locating Seismic-Sense Stations Through Genetic Algorithm

Why is this human competitive?

- The current Seismic Alert System (SAS) has 12 seismic-sense stations.
- SAS alerts the population 60 sec. before seismic wave reaches México City.
- ¿Is it the best configuration?
- ¿Could we find a better configuration?
- ¿Could a genetic algorithm be a good strategy to find a better solution?



Distribution of the current seismic-sense stations SAS



Typical Seismic-Sense Station

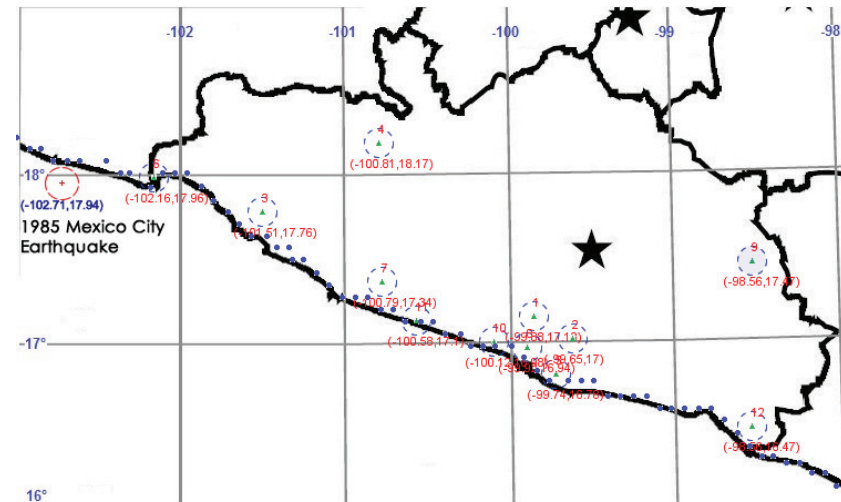
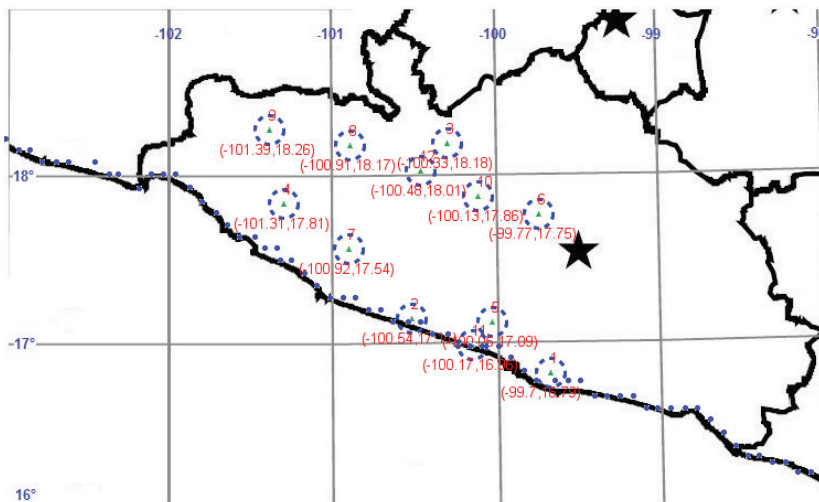
Images taken from CIRES www.cires.org.mx



Locating Seismic-Sense Stations Through Genetic Algorithm

Why is this human competitive?

Best Configuration	All earthquakes		Earthquakes > 5° Richter		Earthquake 1985
	Max.	Avg.	Max.	Avg.	
Current SAS	80	34	80	65.23	57
Genetic Algorithm	99	31.43	99	68.94	89





Locating Seismic-Sense Stations Through Genetic Algorithm

Why is this human competitive?

- The genetic algorithm provided a better solution for the location of the seismic stations.
- Through several experiments, we observed that the time to alert the population of Mexico City was over 50% higher than the current configuration of SAS.



Locating Seismic-Sense Stations Through Genetic Algorithm

Why should we win this competition?

- The main reason is the **social impact**.
- We cannot predict earthquakes, but we can **warn** the population of an impending earthquake.
- We can warn the population **over 30 seconds** before a seismic wave reaches Mexico City.
- This approach could be applied not only in Mexico, but also in other **countries**.
- It is a viable project, which can be implemented in a **short time**.
- Although the genetic algorithm is simple, it can be **efficient** in solving specific problems.
- It could be a designing tool that avoids an **unnecessary expense** due to an incorrect construction of a seismic network.

Thank you!

jier@lasallistas.org.mx
vjier@prodigy.net.mx
ravem@lasallistas.org.mx