#### GNGTS 14-11-2017

# FIRST RESULTS OF A TRI-AXIAL FIBER BRAGG GRATING STRAIN SENSOR

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SENSOR

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### PROJECT GOAL MED-SUV is an European project finalized to the study of Mediterranean volcanoes





### FIBER BRAGG GRATING

# **Fiber Bragg Grating (FBG)**: is a periodic variation of the refractive index of the core fiber



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### THE SENSOR





### INTERROGATION SYSTEM



### ARRAY WAVEGUIDE GRATING



- ► 16 channels, one every 0.8 [nm], 0.6 [nm] FWHM
- ▶ Temperature sensibility ⇒ every 1 [°C] the channels are moving of 2 [pm]

SENSOR

## S-RATIO

 $S(\Delta\lambda_B) = \frac{V_{n+1}(\Delta\lambda_B) - V_n(\Delta\lambda_B)}{V_{n+1}(\Delta\lambda_B) + V_n(\Delta\lambda_B)}$ 

- Costant sorce of light
- Photodiodes whith a costant gain in the used wavelength range
- FBG with a characteristic rest wavelength in the middle of two AWG channels



### STRAIN EVALUATION

# Laboratory test, made using an hydraulic press, confirmed the conversion value of 1 $[\mu\varepsilon/{\rm pm}]$

# We have confirmed this value through the study of seismic and tele-seismic events

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Because of the experimental procedure the sensitivity of the three axes is not the same, being the vertical one the most performing direction

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### RAW DATA SINCE 01-MAY-2016



Meteorological data from the INAF station

Introduction	Sensor	DATA ELABORATION AND MEASUREMENT
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### FITTED DATA SINCE 01-MAY-2016





Position of GPS stations near the MED-SUV site

### UNAVCO EVALUATION SHEET

#### Initial Input Data

Site Name	Longitude	Latitude	E velocity	E vel uncert	N velocity	N vel uncert
	west is negative	south is negative	(mm/yr)	(mm/yr)	(mm/yr)	(m/yr)
ECHR	14,912900000	37,686300000	-11	1	3	1
EINT	14,998333000	37,719467000	8	1	-22	1
ESPC	15,027419000	37,692526000	11	1	-20	1

Primary Output Data					
Translation Vector					
E component ± uncert (m/yr)	0,0027	±	0,00057735		
N component ± uncert (m/yr)	-0,0130	±	0,00057735		
Azimuth (degrees)	168,4				
Speed (m/yr)	0,0133				
Rotation ± uncertainty (degrees/yr)	-0,00008385	±	0,00001230		
Rotation ± uncertainty (nano-rad/yr)	-1463,5043	±	214,7514		
Direction of rotation	clockwise				
Max horizontal extension (e1H) (nano-strain)	2212,0455				
Azimuth of S1H (degrees)	97,8366	or	277,8366272		
Min horizontal extension (e2H) (nano-strain)	-2567,6710				
Azimuth of S2H (degrees)	7,8366	or	187,8366272		
Max shear strain (nano-strain)	4779,7164				
Area strain (nano-strain)	-355,6255				

Other Output					
	Lagrangian strain-rate tensor				
	exx ± uncert (nano-strain)	2123,1856	±	149,8905	
	εxy ± uncert (nano-strain)	-645,6227	±	214,7514	
	eyy ± uncert (nano-strain)	-2478,8112	±	402,4991	
	First invariant of strain-rate tensor (nano-strain)	-355,6255			
	Second invariant of strain-rate tensor (nano-strain)	-0,005679805			
	Third invariant of strain-rate tensor (nano-strain)	-0,005679805			

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### ANNUAL TREND COMPARISON

#### Strainmeter

- Est 36.1  $\mu \varepsilon / y$
- ► North -39.2 με/y
- Vertical 0.17  $\mu \varepsilon / y$

### GPS

- ► Est 2.2 με/y
- North -2.6  $\mu \varepsilon / y$
- ► Vertical 0.18 με/y

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$$\varepsilon_{\mathrm{V}} = -\frac{\nu}{1-\nu} \left(\varepsilon_{\mathrm{E}} + \varepsilon_{\mathrm{N}}\right)$$

### LOCAL SEISMIC EVENT 30-JAN-2017



# THANK YOU FOR YOUR ATTENTION

