

IMAGES AS A SOURCE OF HYDROLOGICAL INFORMATION: THE CASE OF RIVER SURFACE FLOW

SALVATORE GRIMALDI

UNIVERSITY OF TUSCIA, VITERBO, ITALY



MecHydroLab

Mechanical Engineering for Hydrology and Water Science

<http://www.mechydrolab.org/>

→ MEASUREMENTS AND OBSERVATIONS IN THE 21st CENTURY CONFERENCE

21 November 2016 | ESA-Esrin | Frascati, Rome (Italy)



SUMMARY

IMAGES AS A SOURCE OF INFORMATION

THE CASE OF GAUGE-CAM

THE ITALIAN GAUGE-CAM STATION

PARTICLE VELOCIMETRY

FUTURE REMARKS

IMAGES AS A SOURCE OF INFORMATION

IMPRESSIVE EVOLUTION IN OF CAMERAS



FEW CENTIMETERS
FEW GRAMS
FEW \$
HIGH FPS E PXL

IMPRESSIVE EVOLUTION IN THE CAMERA HARDWARE
SUPPORT



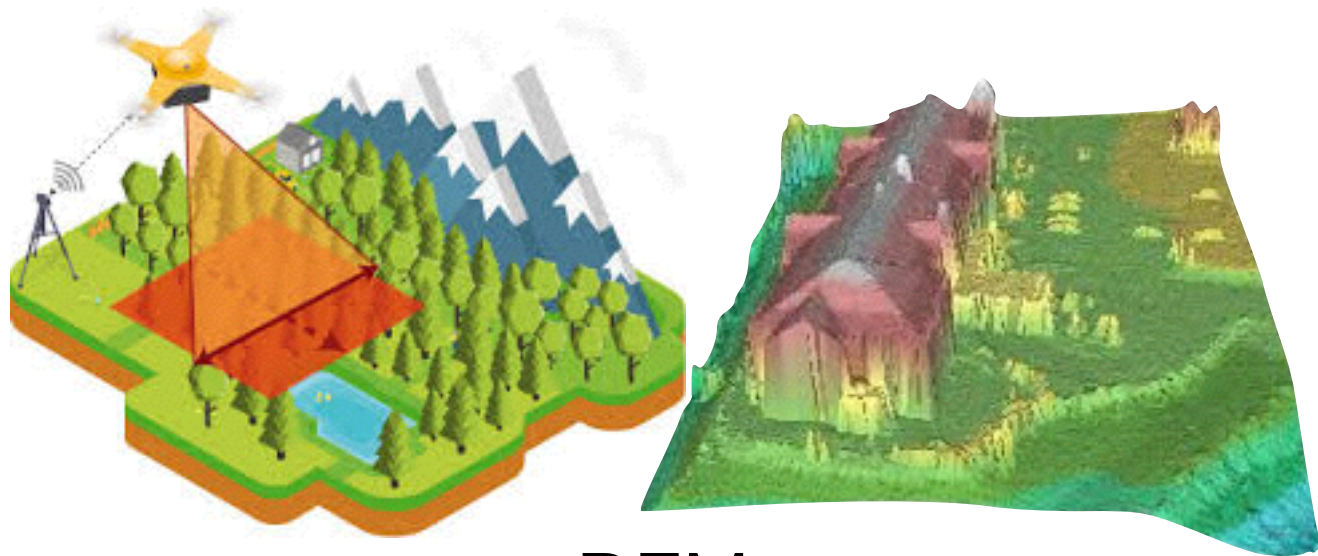
A VARIETY OF POSSIBLE OBSERVATIONS, THIS ONE OF THE CASE THAT
CONFIRMS THE SLOGAN WHEN MOXXI WAS PROPOSED THAT IS.....**FROM THE
LAB TO THE FIELD!**

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IMAGES AS A SOURCE OF INFORMATION

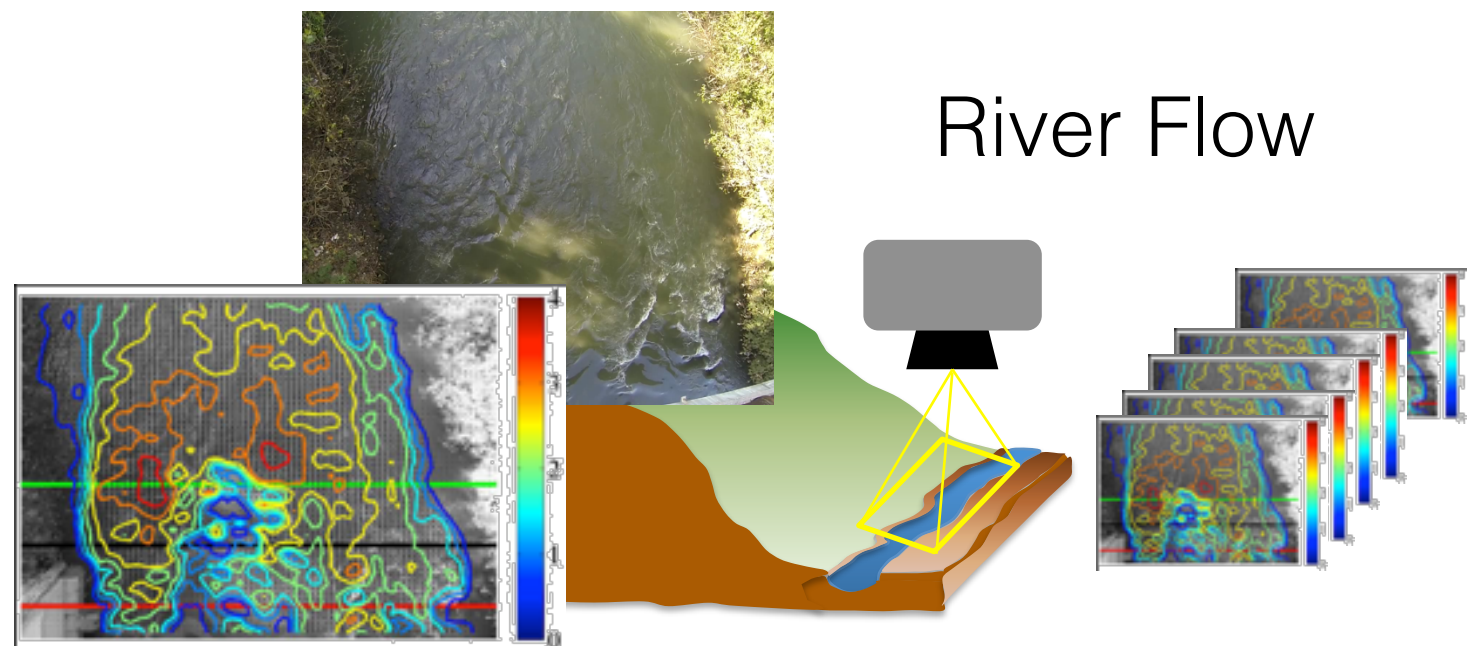
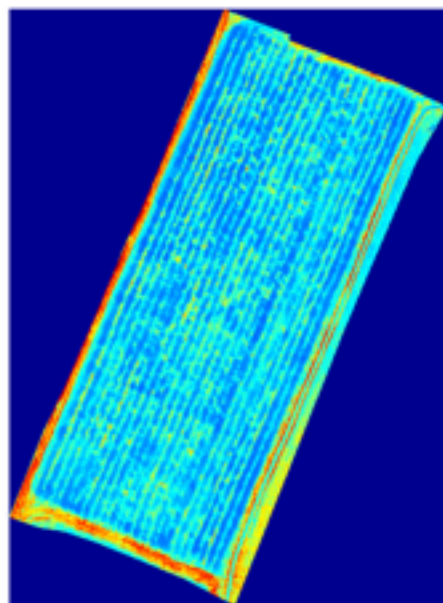


DEM



Rain

Vegetation



River Flow

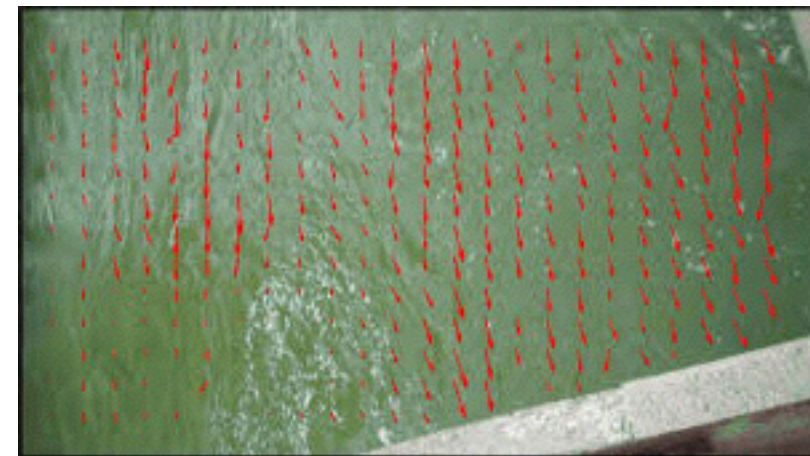
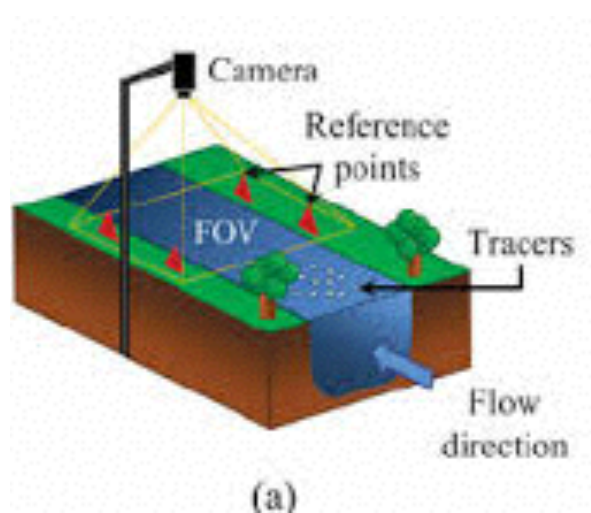
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THE CASE OF GAUGE-CAM

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NOT ONLY SURFACE VELOCITY WITH A PERMANENT GAUGE-CAM STATION

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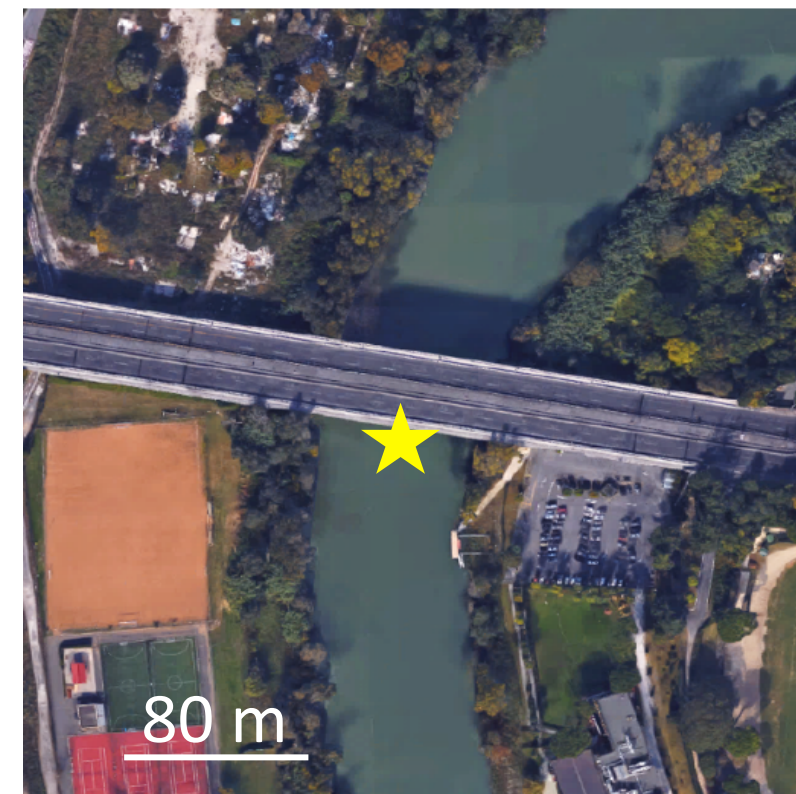
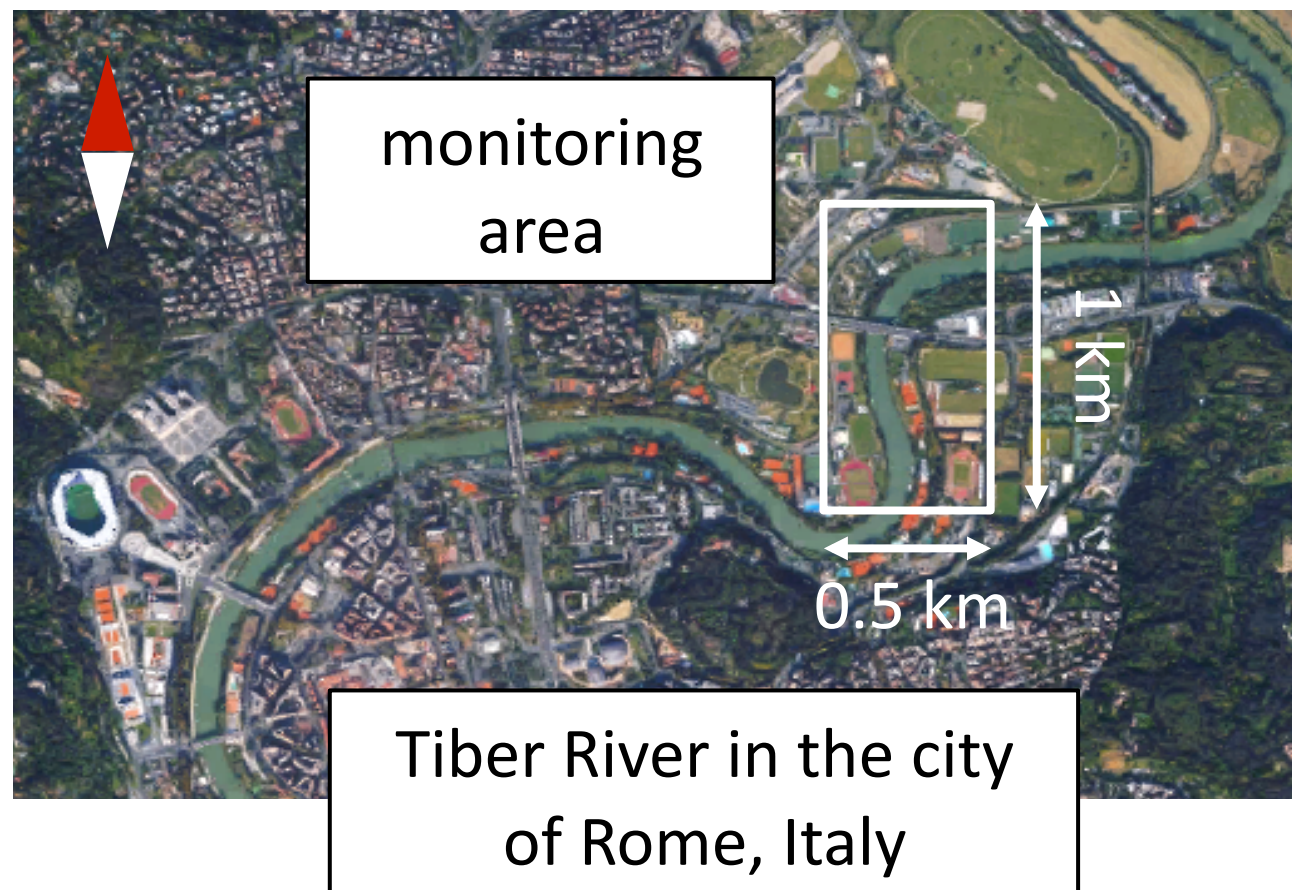
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THE ITALIAN GAUGE-CAM STATION

The gauge-cam station is located in the center of Rome ($41^{\circ}56'22.7''\text{N}$ $12^{\circ}29'09.2''\text{E}$)

It is located next to an existing monitoring station, including a ULM20 ultrasonic meter and an RVM20 speed surface radar sensor



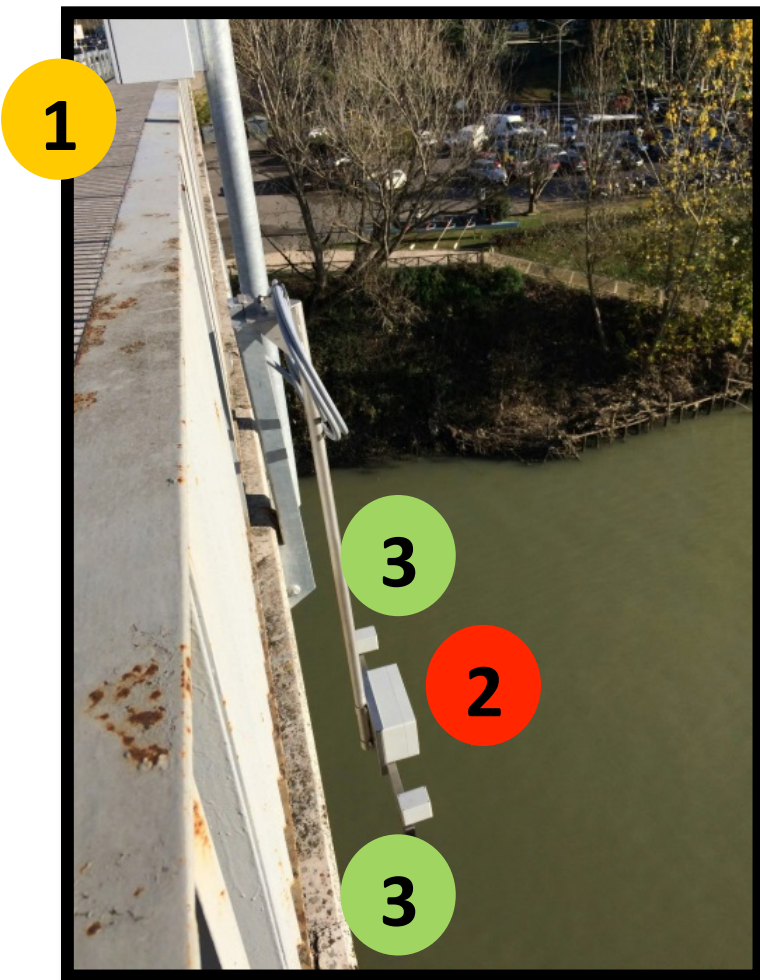
Tauro, F., Petroselli, A., Porfiri, M., Giandomenico, L., Bernardi, G., Mele, F., Spina, D., and Grimaldi, S.: A novel permanent gauge-cam station for surface-flow observations on the Tiber River, *Geosci. Instrum. Method. Data Syst.*, 5, 241-251, doi:10.5194/gi-5-241-2016, 2016.

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THE ITALIAN GAUGE-CAM STATION



CONTROL AND DATA
STORAGE UNIT



INTERNET PROTOCOL CAMERA WITH
TWO MODULES: A FISH EYE LENS
CAPTURES AN EXTENDED AREA AND A
27° LENS CAPTURES FINER DETAILS



GREEN LASERS

- CAMERA AXIS ORTHOGONAL TO WATER SURFACE
- 1 MIN-VIDEO EVERY 10 MIN
- 1024 × 768 PIXELS IMAGES
- MAX FRAME RATE 12 Hz

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THE ITALIAN GAUGE-CAM STATION

NATURALLY-OCCURRING
TRACERS

DATE & TIME

Foro Italico
94.4 lux 71.6 lux

ILLUMINATION
INTENSITY

LASERS' TRACE

LASERS' TRACE

15 m

20 m

006424 UC PE

<SD> FS REC

LEFT-SIDE VIDEO

RIGHT-SIDE FISH-EYE VIDEO

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THE ITALIAN GAUGE-CAM STATION

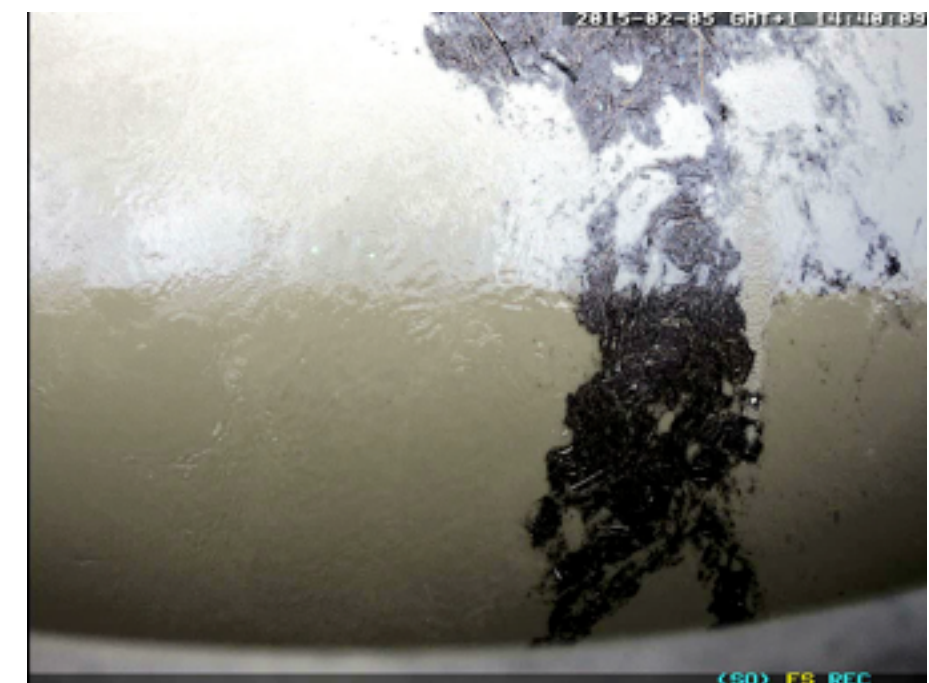
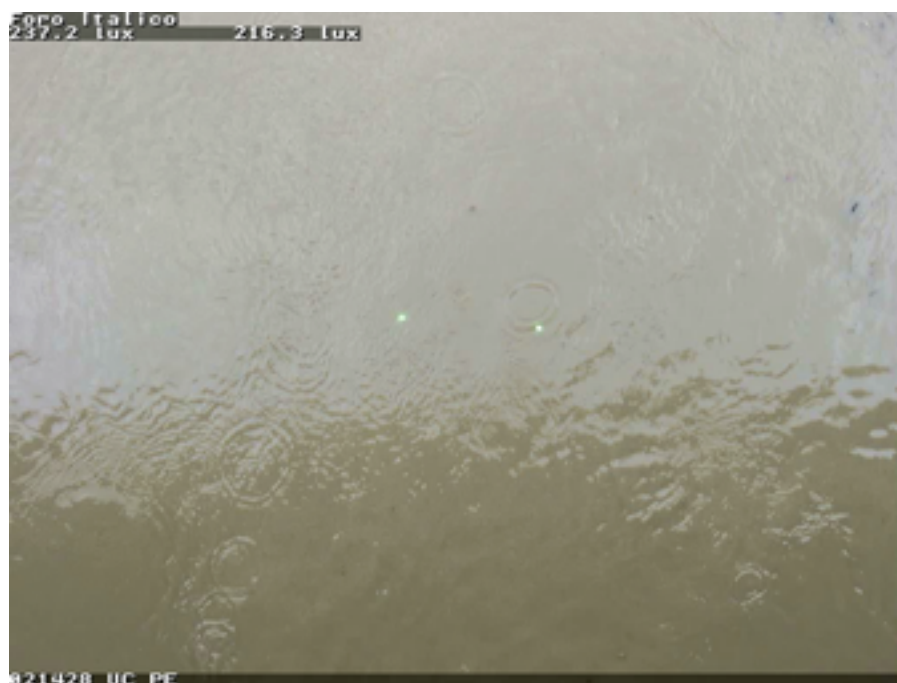
LEFT

RIGHT

VIDEOS RECORDED ON
JANUARY 2ND, 2015



VIDEOS RECORDED
DURING A FLOOD IN
FEBRUARY 5TH, 2015

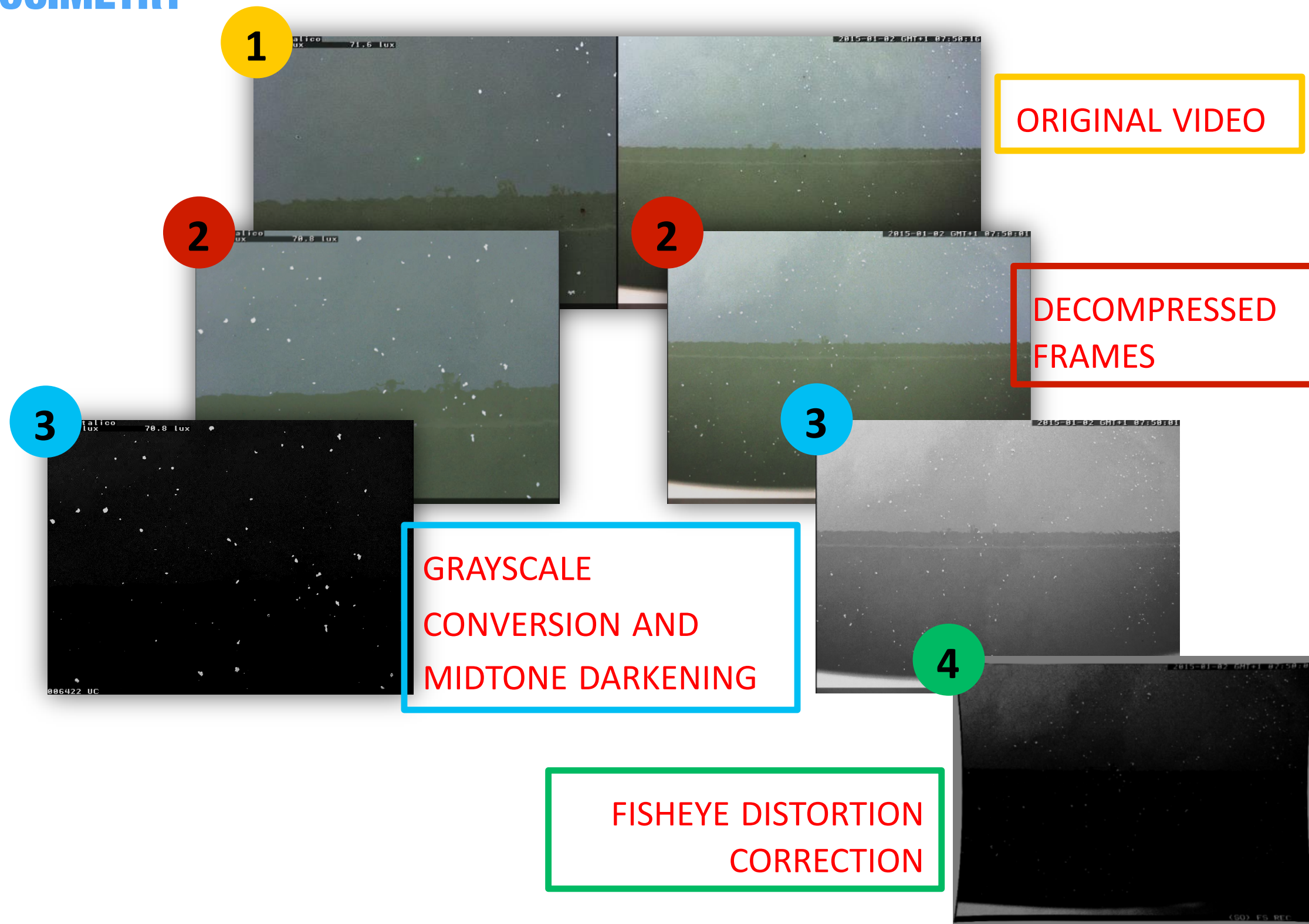


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PARTICLE VELOCIMETRY



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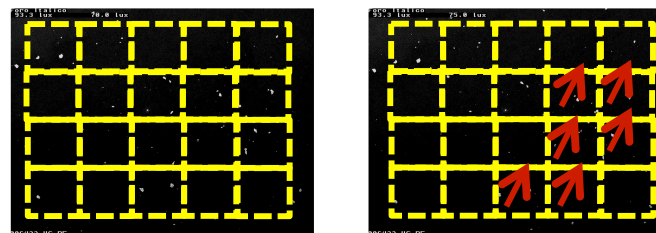
PARTICLE VELOCIMETRY

PARTICLE VELOCIMETRY TECHNIQUE

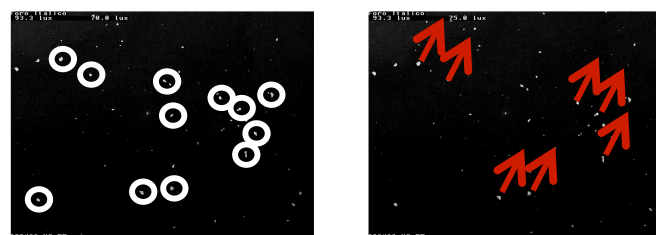


FRAME SEQUENCE

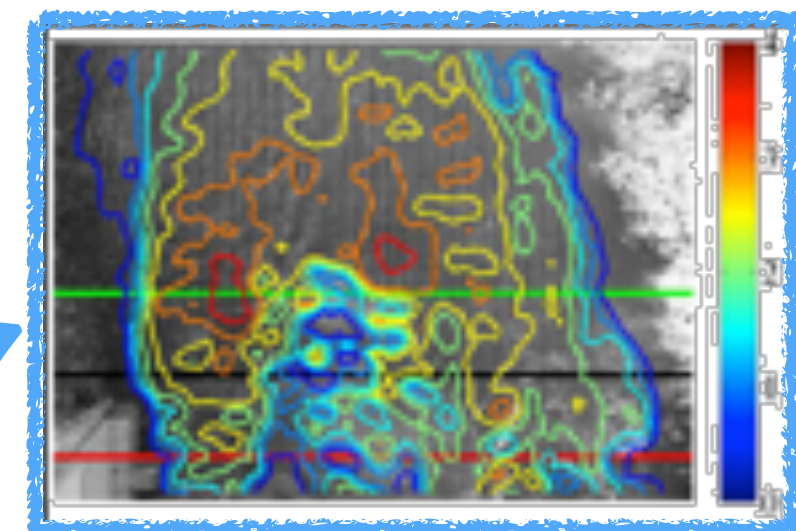
LARGE SCALE PARTICLE IMAGE VELOCIMETRY



PARTICLE TRACKING VELOCIMETRY



SURFACE FLOW VELOCITY MAP

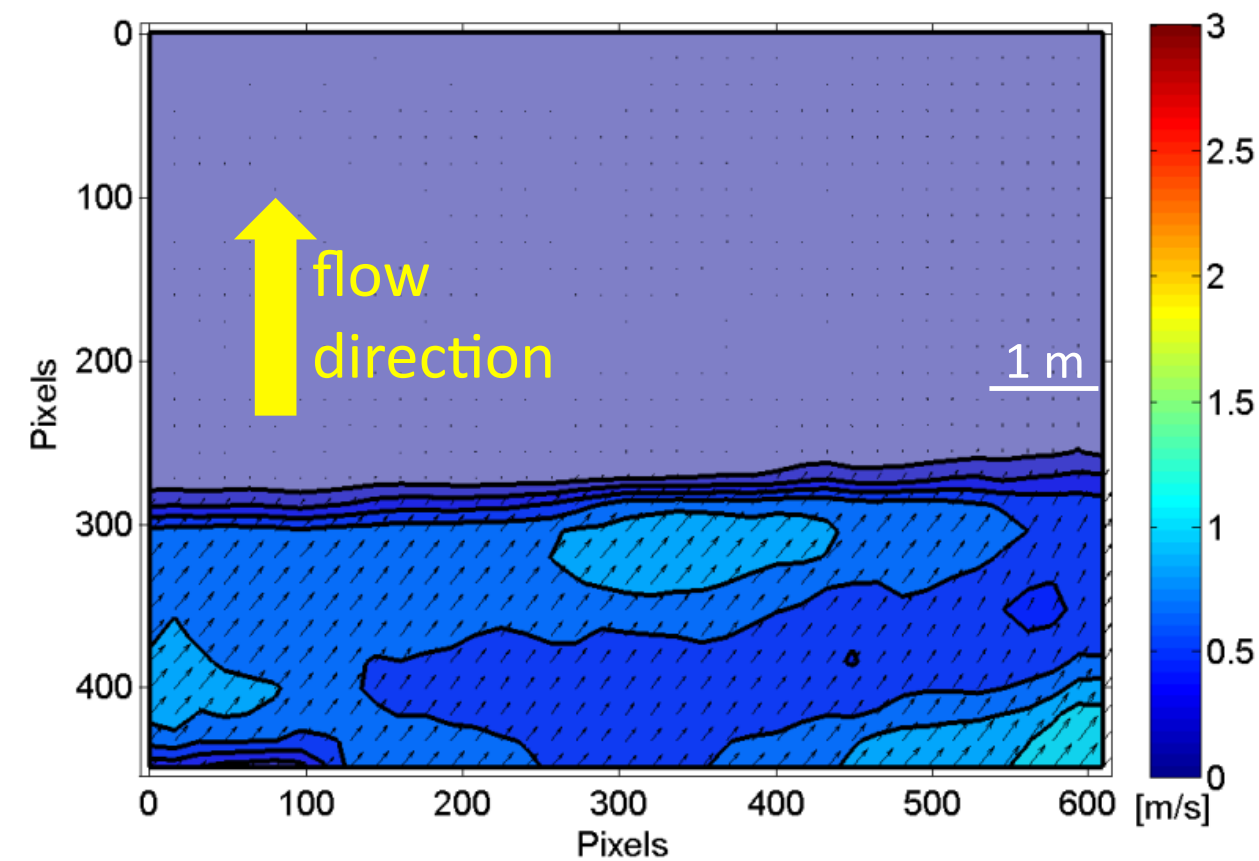


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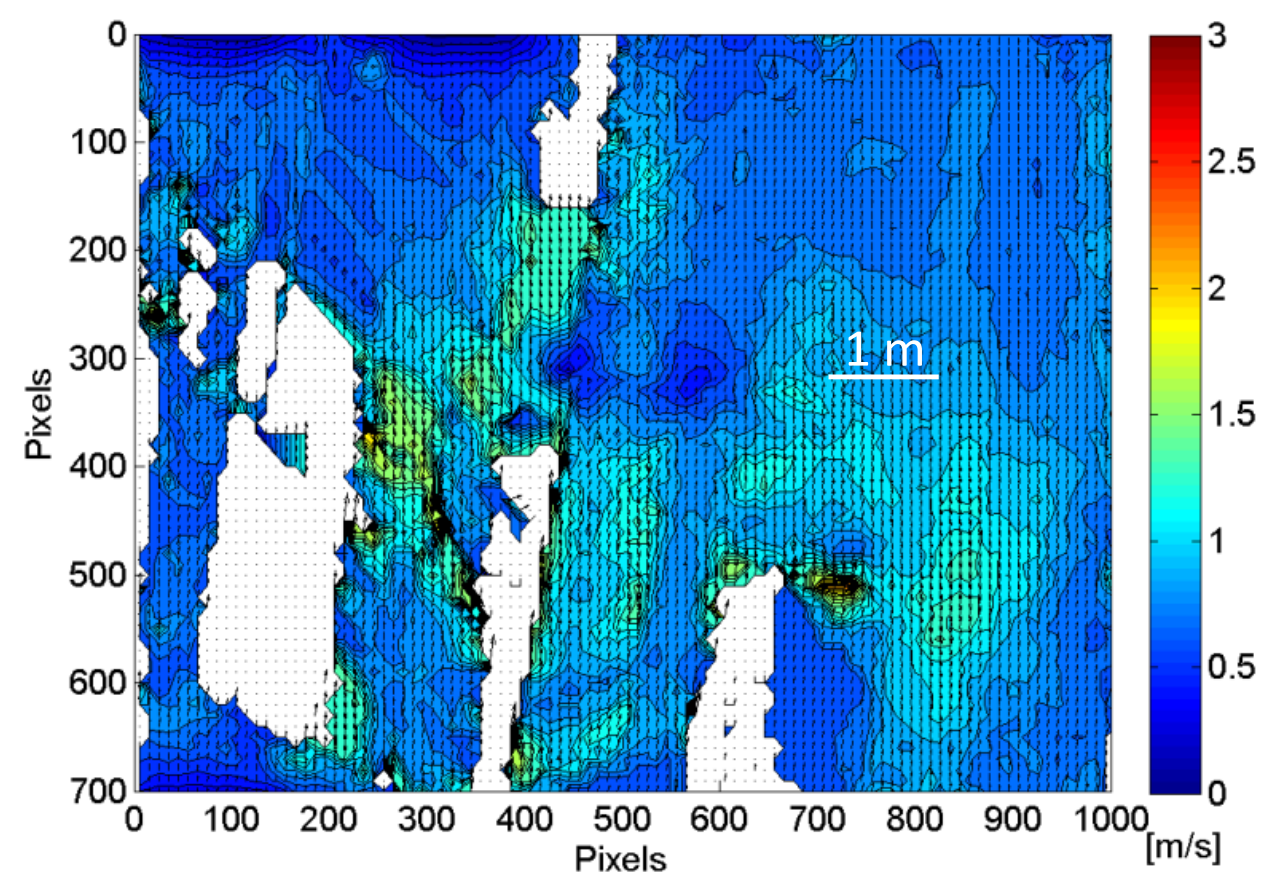


LSPIV



0.35

PTV



0.83

Benchmark Radar velocity = 0.87

LARGE SCALE PARTICLE IMAGE VELOCIMETRY OR PARTICLE TRACKING VELOCIMETRY????

LSPIV

PTV

PRO

NOT DEPENDENT TO THE
FLOATING OBJECT SHAPES

NOT DEPENDENT TO THE AMOUNT OF
FLOATING OBJECT AND BY ITS
HOMOGENEITY IN SPACE AND TIME

CONS

USUALLY IT UNDERESTIMATES VELOCITY
FOR THE NOT HOMOGENEOUS TRANSIT
OF FLOATING MATERIALS.

IT PROVIDES AN ESTIMATION SINCE THE
ERROR CAN NOT BE QUANTIFIED

COMPUTATIONAL TIME

POTENTIALLY IT CAN PROVIDE A
MEASUREMENT SINCE THE SINGLE
TRAJECTORY CAN BE EVALUATED.

OBJECT IDENTIFICATION

COMPUTATIONAL TIME

CONCLUSIONS AND FUTURE REMARKS

GAUGE-CAM IS A PROMISING APPROACH FOR PROVIDING OBSERVATIONS NEVER AVAILABLE BEFORE.

IN THE NEAR FUTURE GAUGE-CAM WILL BE REALLY CHEAP AND WIDELY INSTALLED.

IN ORDER TO BE A REAL INSTRUMENT AN ERROR SHOULD BE QUANTIFIED.

NEXT STEPS IN OUR RESEARCH WILL BE:

- OPTIMIZE THE PTV OUTPUT INCLUDING A TRAJECTORIES SELECTION AND VALIDATION
- REDUCE PTV COMPUTATIONAL TIME IMPROVING THE OBJECT IDENTIFICATION

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THANKS



CIRI
ICT - TECNOLOGIE DELL'INFORMAZIONE
E DELLA COMUNICAZIONE

CIRI • EDILIZIA E COSTRUZIONI
CENTRO INTERDIPARTIMENTALE PER LA RICERCA INDUSTRIALE
UNIVERSITÀ DI BOLOGNA



Monitoraggio Intelligente per Infrastrutture Sicure



POR FESR 2014-2020 - ASSE 1 - AZIONE 1.2.2

Obiettivo generale: realizzare un sistema integrato di monitoraggio e diagnostica applicabile a alvei, argini e sponde ed infrastrutture viarie che, utilizzando tecnologie oggi disponibili, ne incrementino la sicurezza consentendo interventi tempestivi.

Durata: 1.04.2016 - 31.03.2018

Info su: www.infrasafe-project.com

