EDUCATION · TRAINING · RESEARCH

ONE-PIX

PHOTONICS OPEN PROJECTS

FROM MEASUREMENT TO DECISION

CAPABILITY
An open single-pixel chain, from the projected pattern to the reconstruction code

MEASUREMENT
A hypercube produced and checked by the students themselves

USE
Lab classes, long projects, reproduction of published results

DECISION
From student data analysis to a decision-support tool for industry

BEFORE / AFTER

Closed camera, result delivered	→ **Open, modifiable measurement chain**
Dedicated, single-purpose instrument	→ **Kit compatible with your spectrometer**
Buying a piece of equipment	→ **Assembly possible in a fab lab**
Published work hard to reproduce	→ **Shared platform, shared contributions**

TELL US WHAT YOU WANT YOUR STUDENTS TO HANDLE.

A lab class, a teaching sequence, a student project: we will tell you which ONE-PIX configuration fits. Pre-assembled kit or build your own.

Tel. +33 7 83 41 41 36
sales@photonics-open-projects.com
www.photonics-open-projects.com

Your students build the measurement chain that produces their hypercube.

"An open kit that turns your spectrometer into a hyperspectral camera, and puts students in control of every step of the measurement."

1 CURRENT LIMITATIONS

- **The cost of hyperspectral cameras confines them to research platforms.**
  Students graduate having read the theory without ever having produced a hypercube.
- **Commercial instruments return nothing but a result.** Acquisition, modulation and reconstruction remain out of reach.
  There is no way to teach what makes the measurement, nor to question it.
- **Without a shared platform, published work stays hard to reproduce.** Every team rebuilds its own set-up.
  Results cannot be compared from one laboratory to the next.

2 HOW THE KIT WORKS

1. **PATTERN PROJECTION**
   A sequence of light patterns cast onto the scene by a video projector.
2. **SYNCHRONISED MEASUREMENT**
   For each pattern, the mean spectrum reflected by the scene, through a fibre-coupled spectrometer. A Raspberry Pi synchronises projection and measurement.
3. **RECONSTRUCTION AND USE**
   A hypercube reconstructed by algorithm, plus full access to the patterns, raw spectra and reconstruction code. Every step in the chain stays **accessible and modifiable**.

3 PRIORITY APPLICATIONS

INTRODUCTORY HYPERSPECTRAL LAB CLASS

SITUATION	Teaching lab, scene chosen by the students, 50 cm working distance.
MEASURED	400-700 nm hypercube, 2048 spectral bands.
RESULT	An image and a spectrum at every point of the scene.

Students explore data they produced themselves.

TEACHING SEQUENCES ON COMPRESSIVE SAMPLING

SITUATION	Dedicated session: students alter the patterns and the number of projections.
MEASURED	Series of acquisitions with a varying measurement budget.
RESULT	Reconstruction quality as a function of the number of patterns.

Compressive sensing theory becomes concrete.

SEMESTER-LONG STUDENT PROJECT

SITUATION	Fab lab then teaching lab, across a full semester.
MEASURED	Laser-cut assembly of the kit, then acquisitions.
RESULT	A working instrument, documented by the students.

A complete project, from the mechanical drawing to the data in use.

APPLIED RESEARCH AND REPRODUCTION OF RESULTS

SITUATION	Laboratory bench, following a published protocol.
MEASURED	Acquisitions comparable with those of the ONE-PIX community.
RESULT	A direct comparison with work already published.

Extend an existing result instead of repeating it.

WHAT CHANGES

01 OPEN CHAIN
Patterns, raw spectra and reconstruction code stay open to change.

02 SPECTROMETER REUSED
Ocean Optics, Goyalab, Insion, Avantes: the cost is the kit alone.

03 FAB LAB ASSEMBLY
Laser cutting, low voltage, no soldering: the build is a lab class in itself.

04 ACTIVE COMMUNITY
Public files, shared contributions, reproducible results.

TECHNOLOGY LICENSED FROM ARVALIS / PHOTONICS BRETAGNE

SPEC. ONE-PIX

EDUCATION · TRAINING · RESEARCH

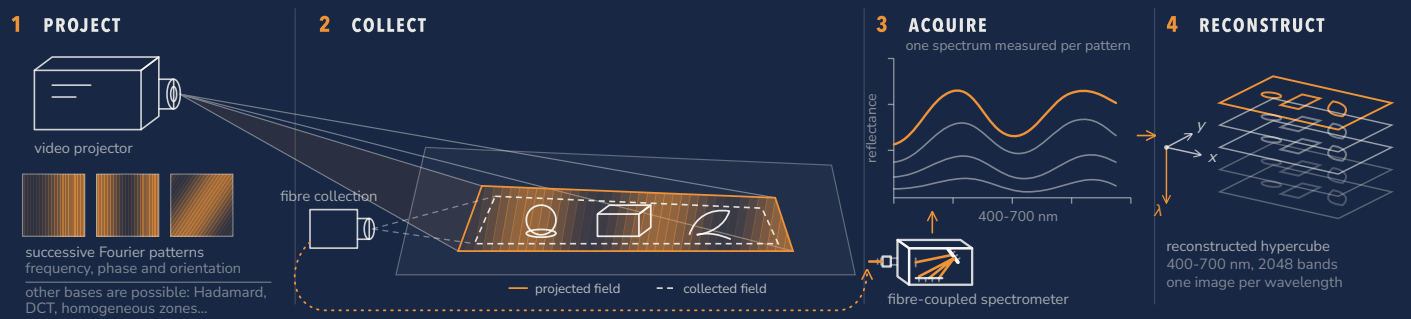
- **An equipment budget that stays within reach**
- **A cross-disciplinary kit: lab classes, projects and research**
- **Resources already in place: GitHub, tutorial, FAQ, video**
- **Co-design of your practical classes**

SPECIFICATIONS

PARAMETER	STANDARD KIT	VIS/NIR OPTION
Technology	Compressive hyperspectral imaging, known as single-pixel imaging	
Spectral range*	400-700 nm	400-800 nm
Spectral resolution*	0.6 nm on average *0.1 to 10 nm FWHM depending on the slit and grating selected*	
Number of spectral bands*	2048 *one measurement point per CCD detector pixel*	
Spectral SNR*	250:1 on a single acquisition	
Integration time*	10 µs to 65 s	
Digitisation*	16 bits	
Recommended working distance	50 cm *Bench set-up, indoors: the scene is lit by the kit's own projector.*	
Recommended projection size (H×W)	21 × 25 cm	
Connectivity	RJ45 or Wi-Fi	
Dimensions (H×W×D) / Weight	220 × 250 × 320 mm / 3,6 kg	
Approach	Cross-disciplinary kit, open to co-designed teaching sessions *optics, electronics, signal processing and programming in a single set-up*	
Compatible spectrometers	Ocean Optics · Goyalab · Insion · Avantes *A spectrometer already in the laboratory can be reused.*	

* depends on the spectrometer paired with the kit. Figures given for an Ocean Optics Flame-S, 2048-pixel Sony ILX511B CCD detector, interchangeable slit.

OPERATING PRINCIPLE: SINGLE-PIXEL IMAGING



1 Fourier patterns projected in sequence · 2 projection and collection fields overlapping on the same area · 3 one spectrum measured per pattern · 4 hypercube reconstruction · Raspberry Pi synchronisation

THEY ALREADY USE ONE-PIX

Institutions and laboratories equipped:

- Institut Agro **Montpellier** (INESAAE) · CentraleSupélec **Metz** · École Centrale **Marseille**, Institut Fresnel · INSA **Lyon**Tech, Electrical Engineering · Université Bourgogne Europe, IUT **Le Creusot** / Polytech **Dijon**, ImViA laboratory · Université de **Caen** · Université Jean Monnet, IUT **Saint-Étienne** · Université de **Limoges**, IUT du Limousin · Université de **Rouen** Normandie · Université d'**Angers**, IRHS · INRAE UMR IRHS · Laboratoire d'Optique et Biosciences, Institut Polytechnique de **Palaiseau** · ENSSAT **Lannion** · Polytech **Saclay** DFTLV, Université Paris-Saclay · industrial users, ... and you
- Contributions shared by the community: deep-learning reconstruction SPyRIT (INSA Lyon, CREATIS), single-pixel object detection SPOD (IETR Lannion), hyperspectral microscopy (Photonics Bretagne), measurement on homogeneous zones (NOKIA / ARVALIS).

WHO FOR?

- **Lecturers and researchers in optics and signal processing**: open up the measurement chain in front of students.
- **Teaching labs and technology halls**: one kit shared across several courses.
- **Research groups and PhD students in unconventional imaging**: reproduce and extend published results.

CONDITIONS OF USE

- Indoor use: the scene is lit by the kit's own projector.
- Recommended working distance 50 cm, projection 21 × 25 cm.
- 300 W max power draw; a compatible spectrometer is required, supplied or already on site.

LET'S BUILD YOUR SESSION TOGETHER.

We start from your teaching goal and build a progression for your students. Indicative lead time: one month.

WHAT TO SEND US

→ The level and class size involved
→ The concept you want handled
→ The spectrometer you already have

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