Internships AA19/20

Research opportunities

Important Disclaimer

Internships are activated within existing research collaboration with companies / research institutions and typically lead to a full-thesis project, like any other research thesis.

In some cases, you will be **collaborating with other MsC/PhD students** that are currently **involved in the same research project**

For any enquiry

Just drop me an email and we can arrange a short meeting to discuss…

giacomo.boracchi@polimi.it

Internships@STMicroelectronics

Agrate Brianza

General Conditions

The research thesis will be carried out under the joint supervision of the Applied Math team in the STMicroelectronics Labs (Agrate Brianza, via Camillo Olivetti, 2).

- Internship lasts 6 months and it’s typically extended if necessary up to other 6 months
- The net salary is 600 €/month
- Canteen + transportation from Gobba / Lambrate included

Stage ST1: Wafer Defect Maps Monitoring

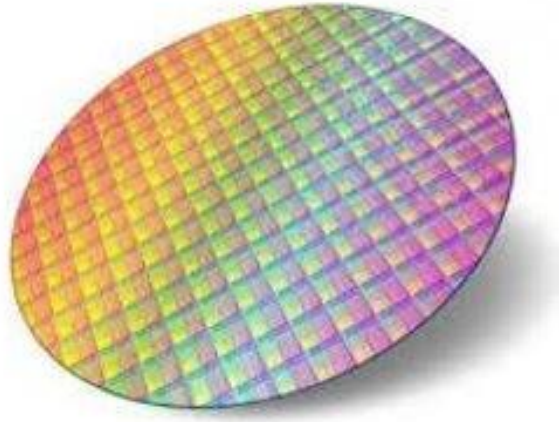
Background

Semiconductor manufacturing is a **long, complex and expensive** process involving several specialized steps

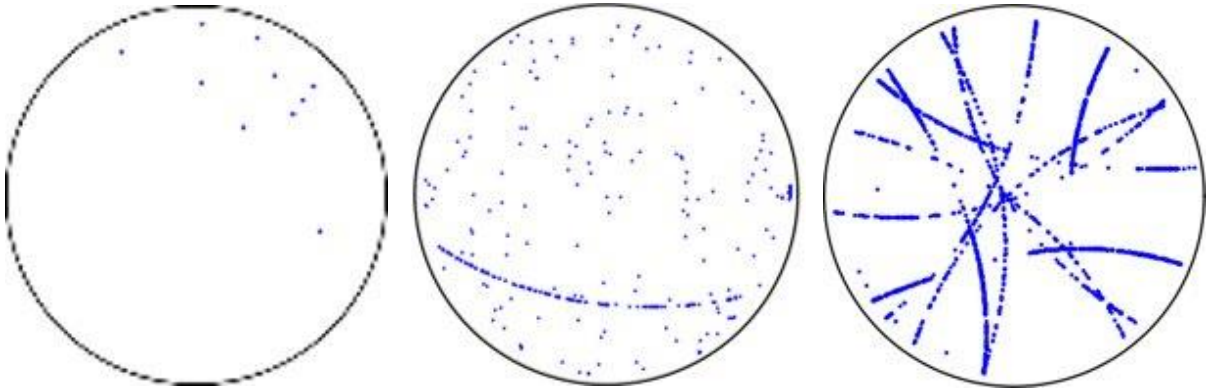
Inspection tools provide a **huge amount of data**, that can be entirely analysed only by **Deep Learning** techniques

Deep Learning enables the **automatic** monitoring of the production lines, **identifying defective patterns**. The results of this procedure allow to discard defective products and might promptly reveal failures of the machines

A wafer containing multiple chips



Examples of wafer defect maps



Stage ST1: Wafer Defect Maps Monitoring

Research Directions

Currently, our automatic solution based on a CNN is classifying WDMs on the major production lines of STMicroelectronics site in Agrate. Future research will address

- The study of **domain adaptation** techniques to handle data coming from different production processes
- The development of a solution to **identify the type of malfunctioning** and localize the faulty machinery in the production pipeline
- The development of an **anomaly-detection network** to identify never seen defective patterns

Materials and methods:

- Annotated WDM dataset
- Support from ST's engineers
- Reference algorithm based on sparse convolutions

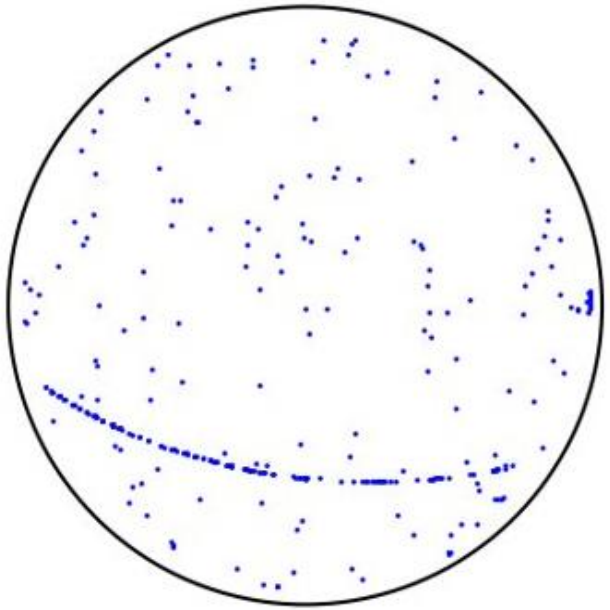
Stage ST2: Continuous Convolutions to learn from unstructured data

Background

Most DL algorithms are based on **discrete convolution**, an operation defined for data with an underlying **grid structure** (e.g. images)

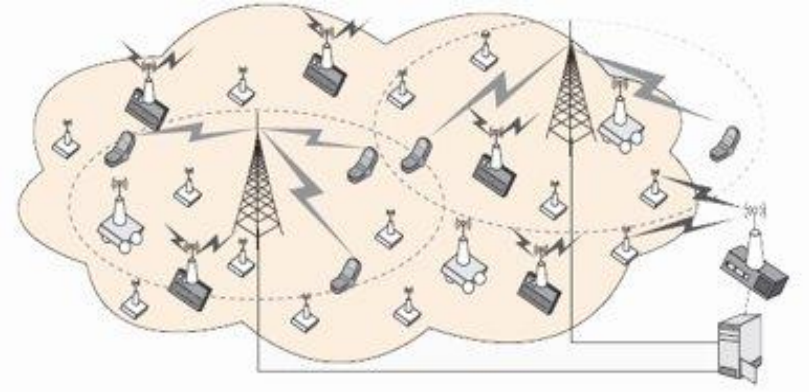
Industrial data might lack such a structure. For instance, data might consist of a set of **3D points or measurements in scattered locations** (e.g. point clouds, defect maps, sensor networks acquisitions)

A popular solution is to **discretize** the data points and force them into a grid structure. However, this procedure might cause a **loss of information**



A Wafer Defect Map (WDM) is a list containing the coordinates of the defects on a wafer. Defects are displayed on a huge grid (20,000 x 20,000) that would be impossible to handle as an image

The sensors of a network might not be positioned on a regular grid. Hence, discrete convolutions might not be applied to the sensors' positions and acquisitions



Research Directions

Stage ST2: Continuous Convolutions to learn from unstructured data

Goals: develop new DL methods to handle and learn directly from sets of points. In particular, this project will address:

- The study of **continuous convolutions**, where the kernel is a **continuous function** instead of a discrete matrix
- The design of a **continuous convolutional** layer
- The development of a DL architecture based on continuous convolutions and validation of the solution

Materials and methods:

- Access to a server mounting GPUs will be provided
- Annotated from sparse wafer defect maps, public datasets point clouds
- Reference algorithm based on sparse convolutions

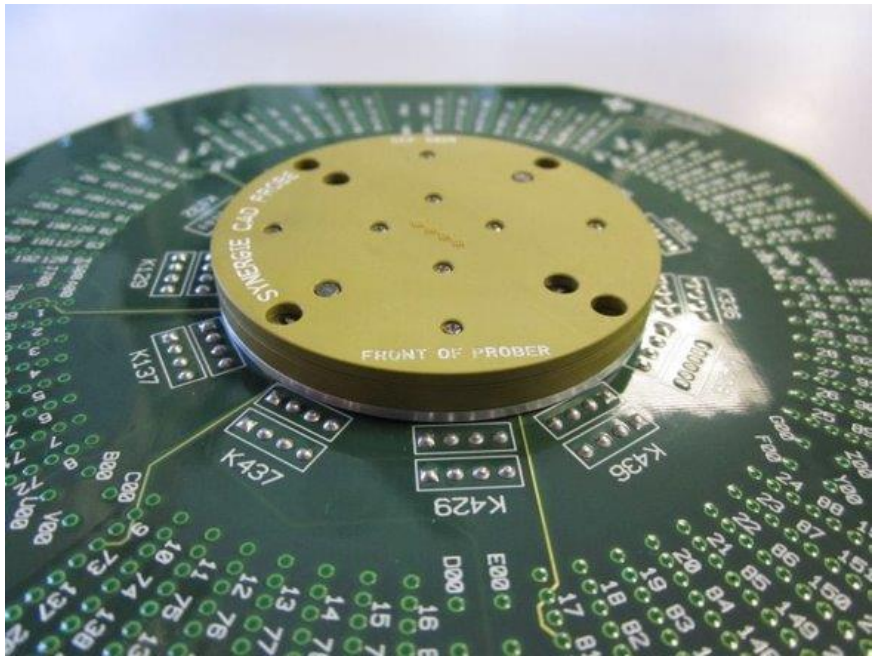
Stage ST3: Deep Learning for Predictive Maintenance

Background

In semiconductor manufacturing, different Automatic Test Equipments (ATEs) are used to perform the Electrical Wafer Sorting (EWS) Test, which identifies malfunctioning chips within wafers.

In order to provide **accurate results**, each ATE is supposed to operate without alterations and **consistently** with the other ones.

Deep Learning techniques can be used to enable **predictive maintenance** of the ATEs, avoiding failures and thus reducing costs.



semiconductor wafer prober,

Stage ST3: Deep Learning for Predictive Maintenance

Research Directions

The goal of this project is to develop **real-time monitoring** techniques for ATEs to **identify malfunctioning** and drifts from the expected behaviour. Research directions include:

- Data driven **modelling** of the input data based on DL techniques
- Real-time data **monitoring** and comparison with **models** learned in normal conditions
- **Automatic recalibration** of the ATEs leveraging the information obtained through the monitoring phase.

Internships@Fondazione Don Gnocchi

Milano

General Conditions

The research thesis will be carried out under the joint supervision of the Wearable Sensor and Telemedicine Laboratory coordinated by Ing. Marco Di Rienzo (Milano, via Capecelatro).

- Internship lasts 6 months and it’s typically extended if necessary
- The net salary is 300 €/month
- Canteen included

Stage: Algorithms for seismocariogram analysis in Wearable Devices

Background

Seismocardiogram (SCG), records micro-accelerations of the chest wall due to the heart movements. In contrast with ECG:

- SCG provides a direct measure of the heart mechanical activity, and not just the heart electrical activity (assessed by the ECG).
- The analysis of SCG is a quite new activity, and efficient automatic algorithms for segmenting, classifying and identifying anomalies in this signal have still to be investigated.

- Recently, Fondazione Don Gnocchi developed a wearable system for SCG monitoring, which have been used to monitor patients in clinics, and also in the International Space Station to monitor astronauts during their sleep.
- See the video at http://ow.ly/7z7Q30mgI1K

SeisMote

Thesis proposal: ML methods for Seismocariogram analysis

Research Directions

Goals:

- Develop data-driven algorithms for the automatic localization of specific patterns within the SCG waveform associated with salient moments of the cardiac cycle, including the opening and closure of valve
- Optimize algorithms to enable SCG monitoring, on the wearable device.

Materials and Methods:

- The activity will be carried out in collaboration with the Wearable Sensor and Telemedicine Laboratory coordinated by Ing. Marco Di Rienzo, of the IRCCS Fondazione Don Carlo Gnocchi Hospital in Milano.
- The SCG recording device (SeisMote) as well as annotated datasets from patients will be available for the thesis.

Collaboration with Fondazione Don Carlo Gnocchi Onlus

Internships@Cisco

Vimercate, via Santa Maria Molgora 48C

General Conditions

The candidate will develop the internship at CISCO photonics office in Vimercate via Santa Maria Molgora 48C.

Laboratory activities, Theoretical and on-the-job training is planned in preparation to the intership.

Cisco will also provide:

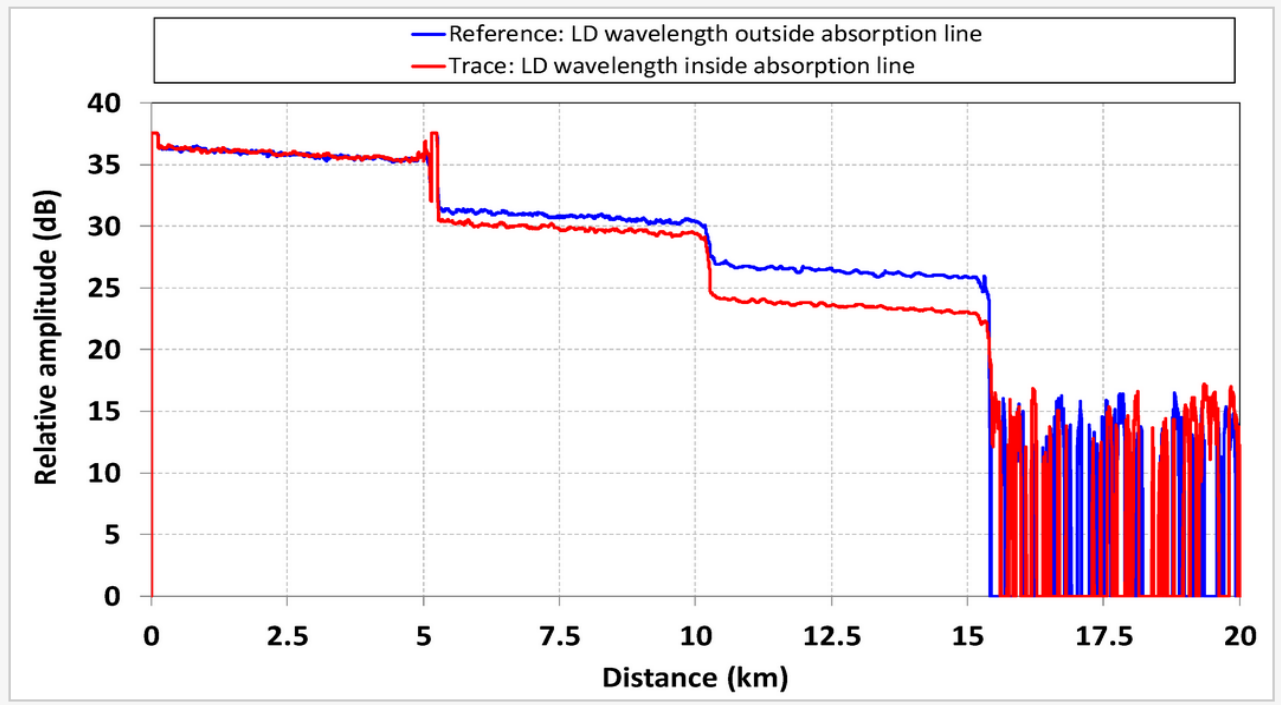
- All the equipments required in the research activity.
- Tickets restaurant.
- A salary (intership compensation).

Stage CISCO: OTDR events recognition

Background

OTDR (optical time domain reflectometer) is a technique to analyse a portion of an optical fiber.

The output of OTDR is a signal representing the optical power (in dB) as a function of the distance (in Km) along the fiber.

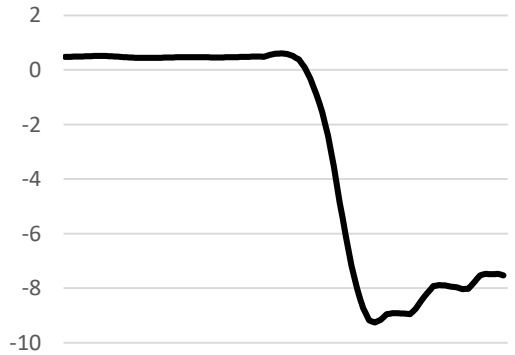


Stage CISCO: OTDR events recognition

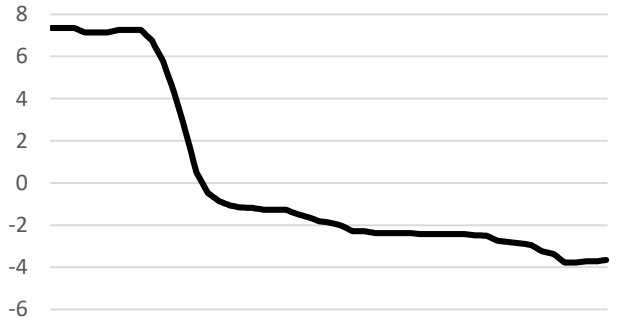
Background

Every span of optical fiber in the field features its own characteristic. ODTR signal has the potential to identify whether some event has occurred in the fiber span.

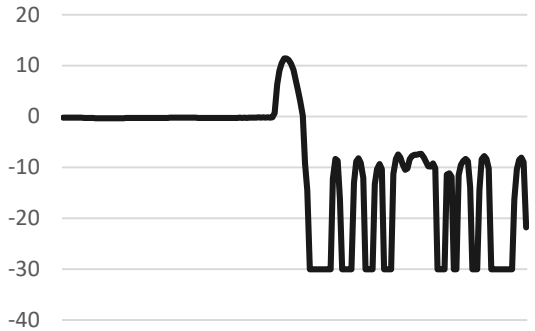
In practice, by analyzing OTDR signal it is posible to identify at which location in the fiber there has been a cut, a strong attenuation, the presence of reflection sources, or concentrated losses, to name a few examples:



FIBER CUT



ATTENUATION



FIBER KNOTTED

Stage CISCO: OTDR events recognition

Research Directions

Goals:

- Implement a deep learning model to detect (multiple) patterns inside an ODTR signal. The model has to be 1-dimensional and able to cope with input signals of different dimensions.
- Define realistic data augmentation procedures in collaboration with CISCO engineers and scientists.
- Data set manipulation and preparation.
- Comparison among different solutions (expert-driven vs data-driven)
- Porting the final model on a real embedded systems.

Materials and Methods:

- OTDR measurements from real fiber deployed in multiple sites.
- CISCO engineers will provide all the guidance and equipments needed.

Thesis@Cleafy

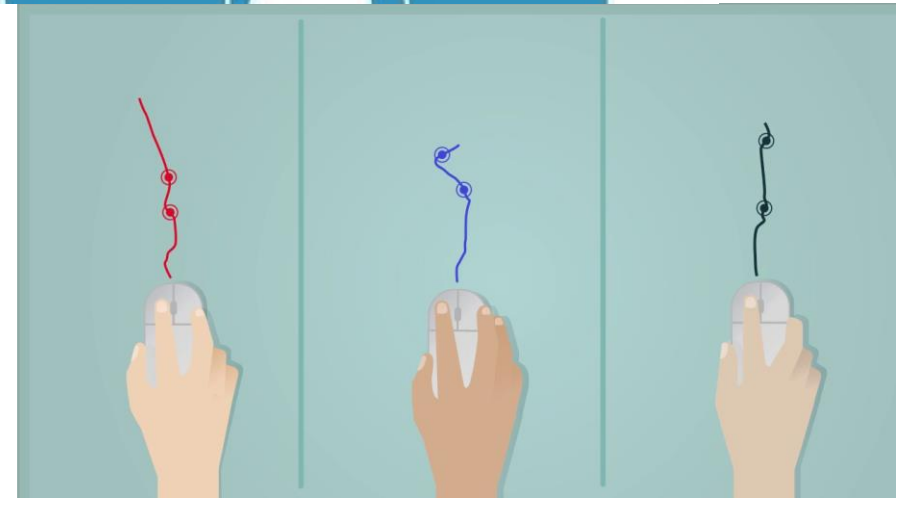
Milano, via Schiaffino 11

Background

Behavioral biometrics

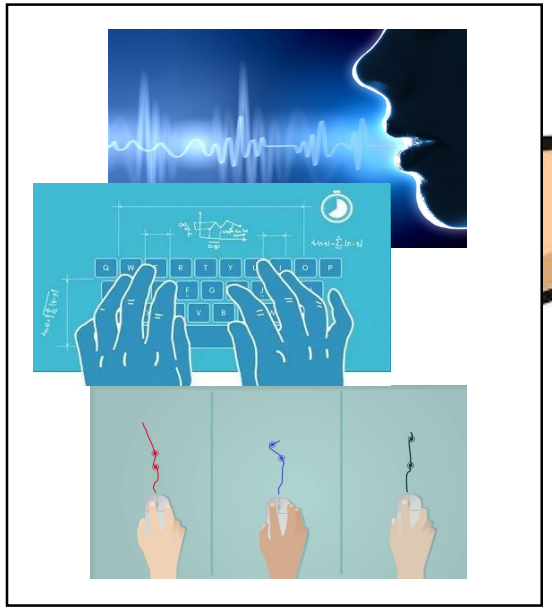
Behavioral biometrics is the study related to **uniquely identifiable** and **measurable patterns** in human **activities.**

Behavioral biometric verification methods include **keystroke dynamics, gait analysis, voice ID, mouse use characteristics, signature analysis** and **cognitive biometrics.**



Behavioral biometrics for fraud detection

Background



.Cleafy

- Discriminate between **humans** and **bots** (prevent **automated attacks**).
- Identify **fraudsters** (previously seen **malicious behavior**).
- Predict the **credentials** through which the user will **authenticate** himself (likelihood of being a **specific known user**).
- Corroborate the identity of an **authenticated user**.

Thesis: User Identification

Research Directions

Goal: Design and prototype an algorithm able to **verify** the user **identity** through his **behavioral biometrics** during a navigation session.

- Getting familiar with **state-of-the-art** behavioral biometrics verification **methods**.
- Robustly **profile users** through the various aforementioned metrics.
- **Continuously** (and **frictionless**) **verify** the users **identities** during sessions.

Materials and Methods:

- Access to a server mounting GPUs will be provided
- Anonymized data acquired from a large database of users

Collaboration with

Cleafy