



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

ARCES Ricerca

Modellazione fisica al supporto del monitoraggio strutturale

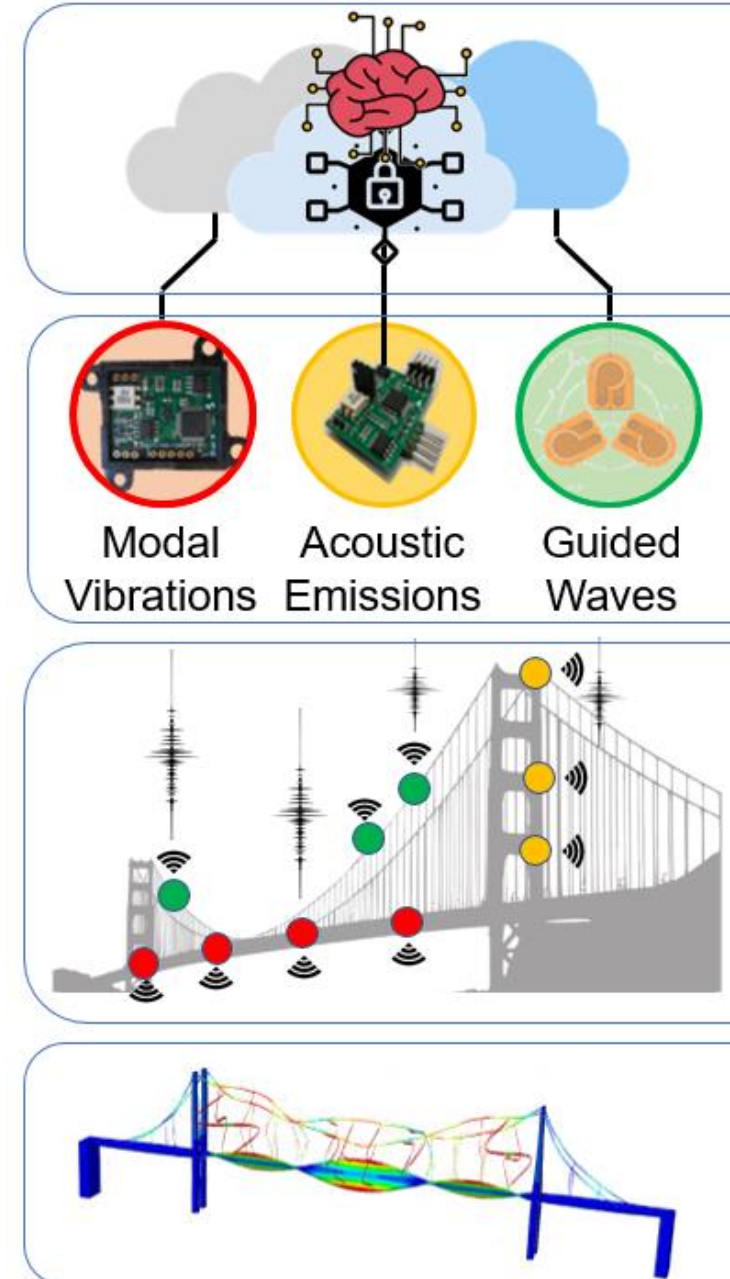
Alessandro Marzani

Advanced Research Center on Electronic Systems

Dipartimento di Ingegneria Civile, Chimica, Ambientale e dei
Materiali

Competenze

- **Comprensione del comportamento**
 - Materiali
 - Strutture
- **Sviluppo codici di modellazione dedicati**
 - Diverse fisiche
 - Multifisica
- **Competenza nell'uso di software commerciali**
 - Formazione
- **Sviluppo di algoritmi di interfacciamento**
 - Open software – API software commerciali
 - Model updating
 - Gemelli digitali



- **TÜV AUSTRIA (11/22 – 10/25)**
“Acoustic emission based monitoring of composite pressurized vessels”
- **INAIL (11/21 - 10/23)**
“Industrial and Civil Digital Smart Structures”
- **ENI (01/23 - 06/23)**
“Tank integrity monitoring”
- **SALCEF GROUP (01/22 - 07/26)**
“Structural Health Monitoring of railway bridges”



IDEA

Unproven concept, no testing has been performed



BASIC RESEARCH

You can now describe the need(s) but have no evidence



TECHNOLOGY FORMULATION

Concept and application have been formulated



LARGE SCALE PROTOTYPE

Tested in intended environment



DEMONSTRATION SYSTEM

Operating in operational environment at pre-commercial scale



FIRST OF A KIND COMMERCIAL SYSTEM

All technical processes and systems to support commercial activity



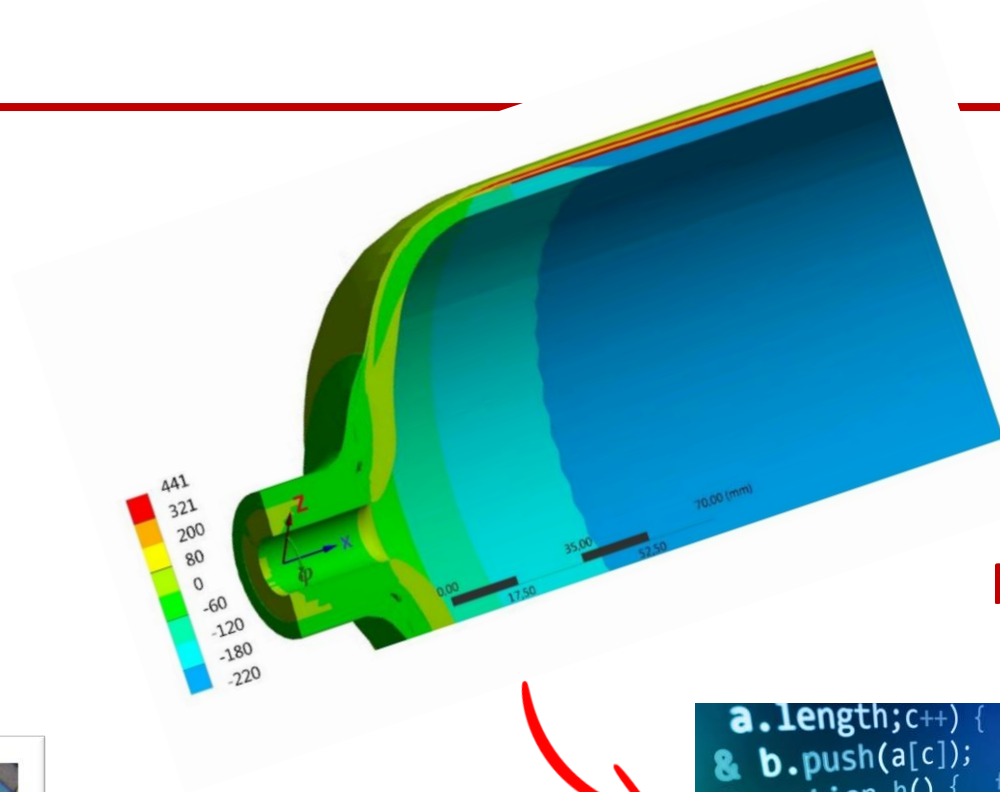
FIRST OF A KIND COMMERCIAL SYSTEM

All technical processes and systems to support commercial activity



FULL COMMERCIAL APPLICATION

Technology on 'general availability' for all customers



Metodologia

```
a.length;c++) {      θ == r(a,c)
& b.push(a[c]);    } return b;
function h() {      for (var a = $(
#User_logged".a(), a = q(a), a
place(/ +(?= )/g, ""), a = a.split(
), b = [], c = 0; c < a.length;c+
) == r(a[c], b) && b.push(a[c]
c = {}; c.j = a.length;
c = b.length - 1;
var a = b;
} }
```

Tecnologia

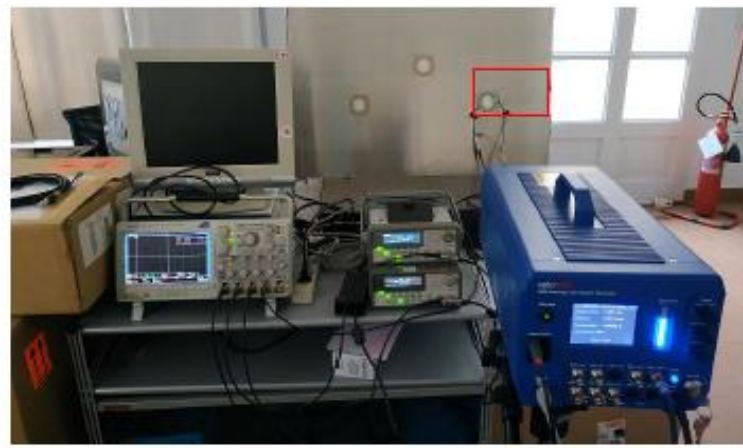
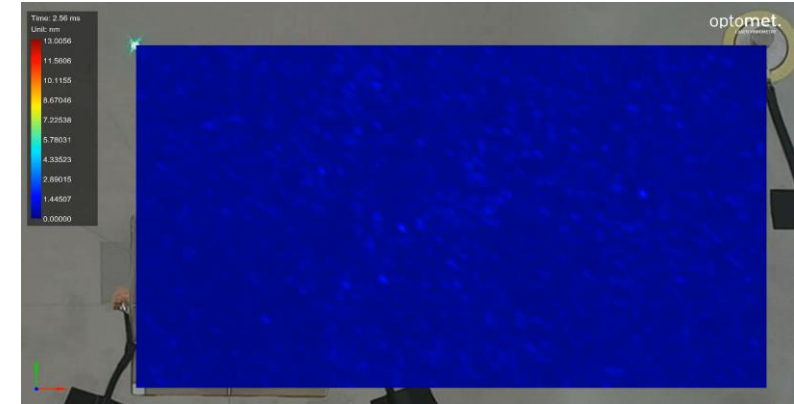
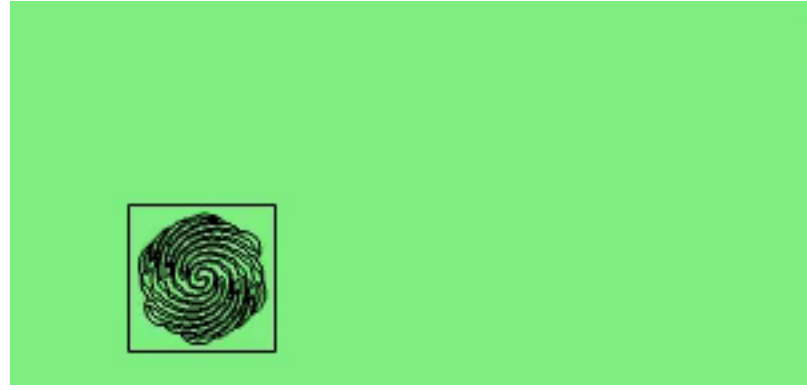




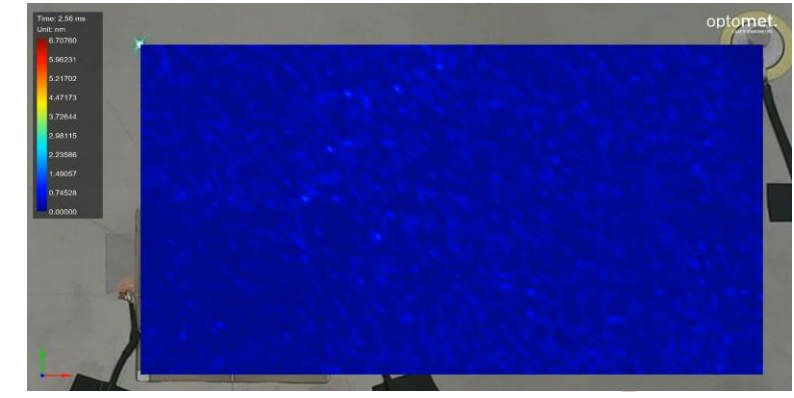
FEM

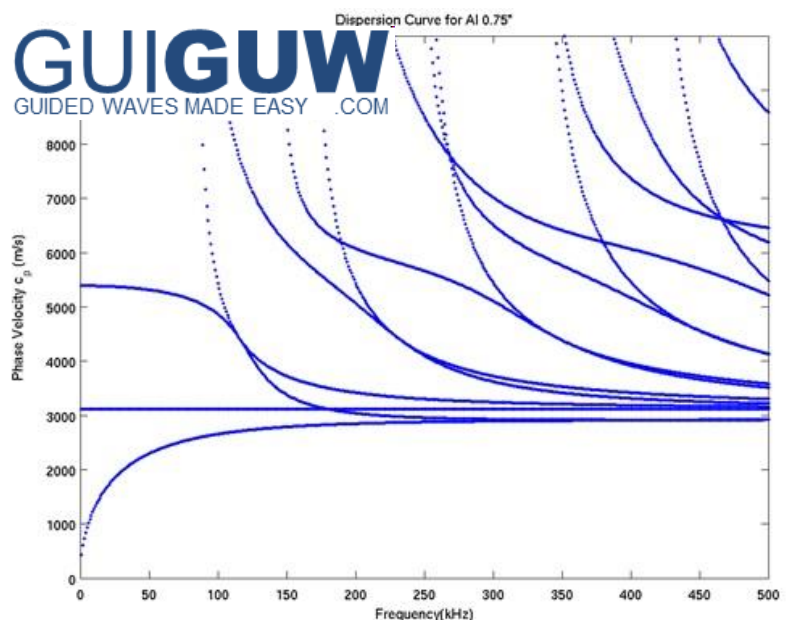
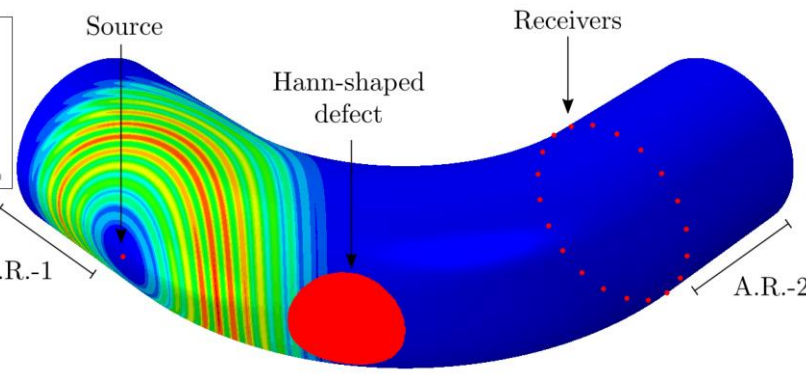
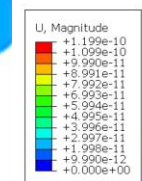
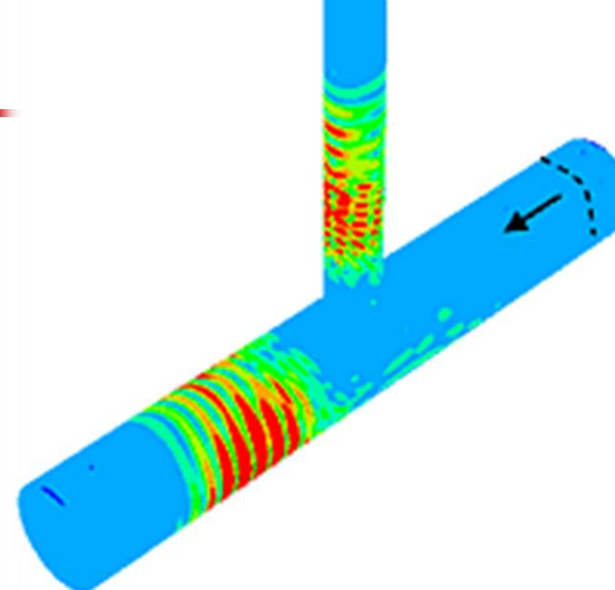
LDV

100 kHz



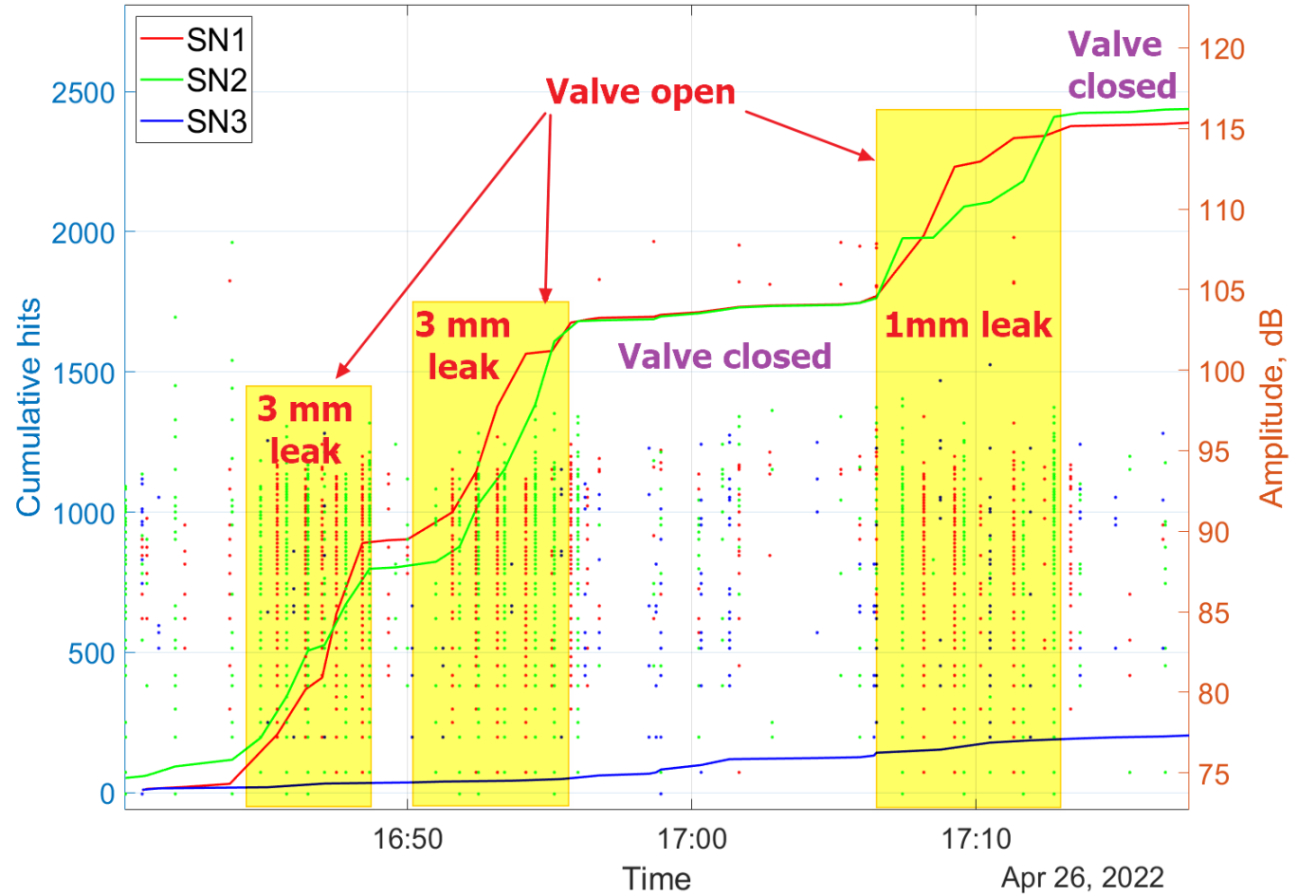
150 kHz

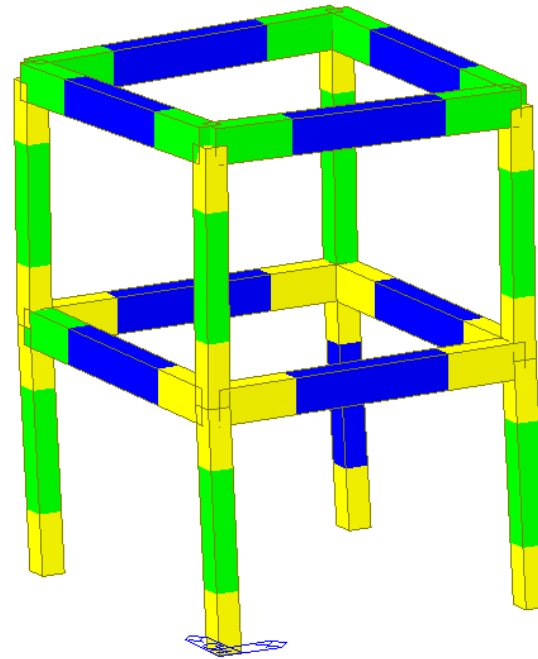
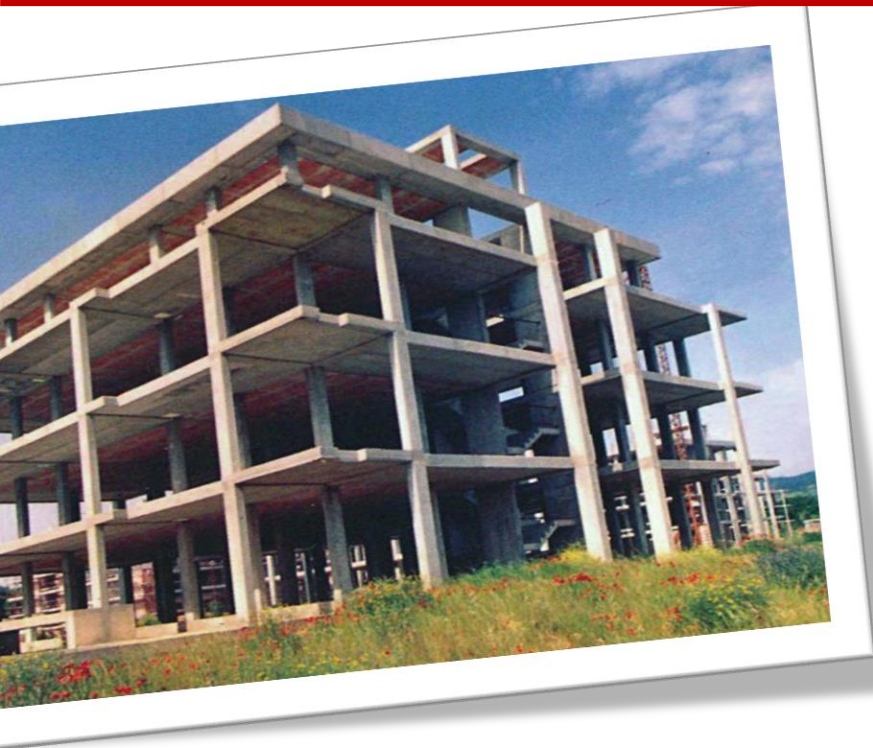




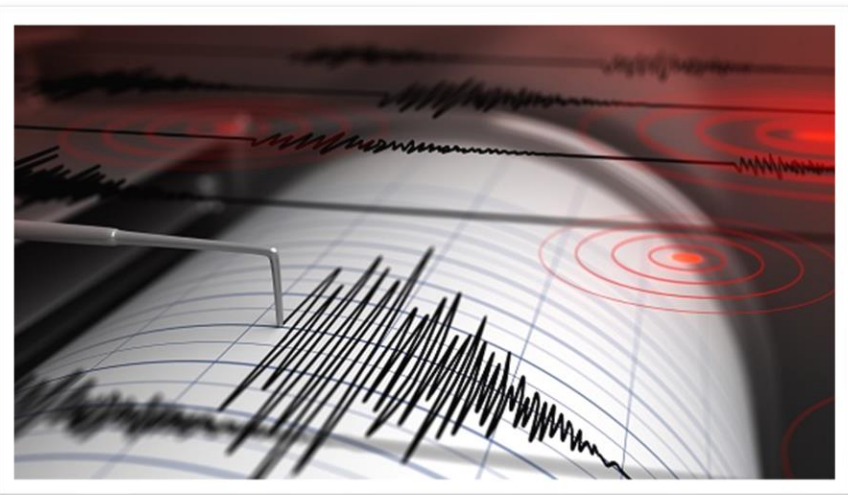
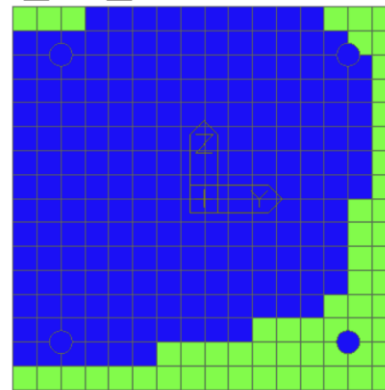


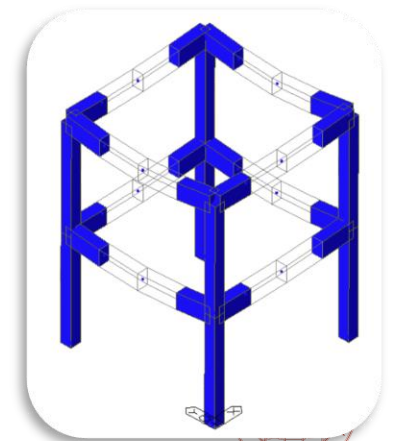
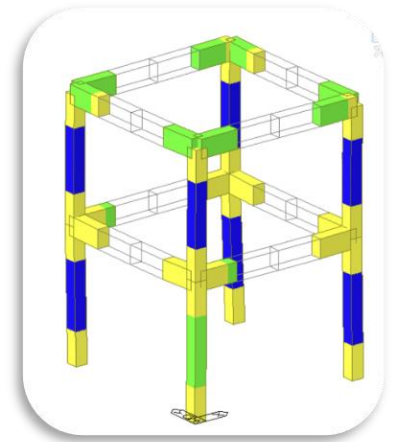
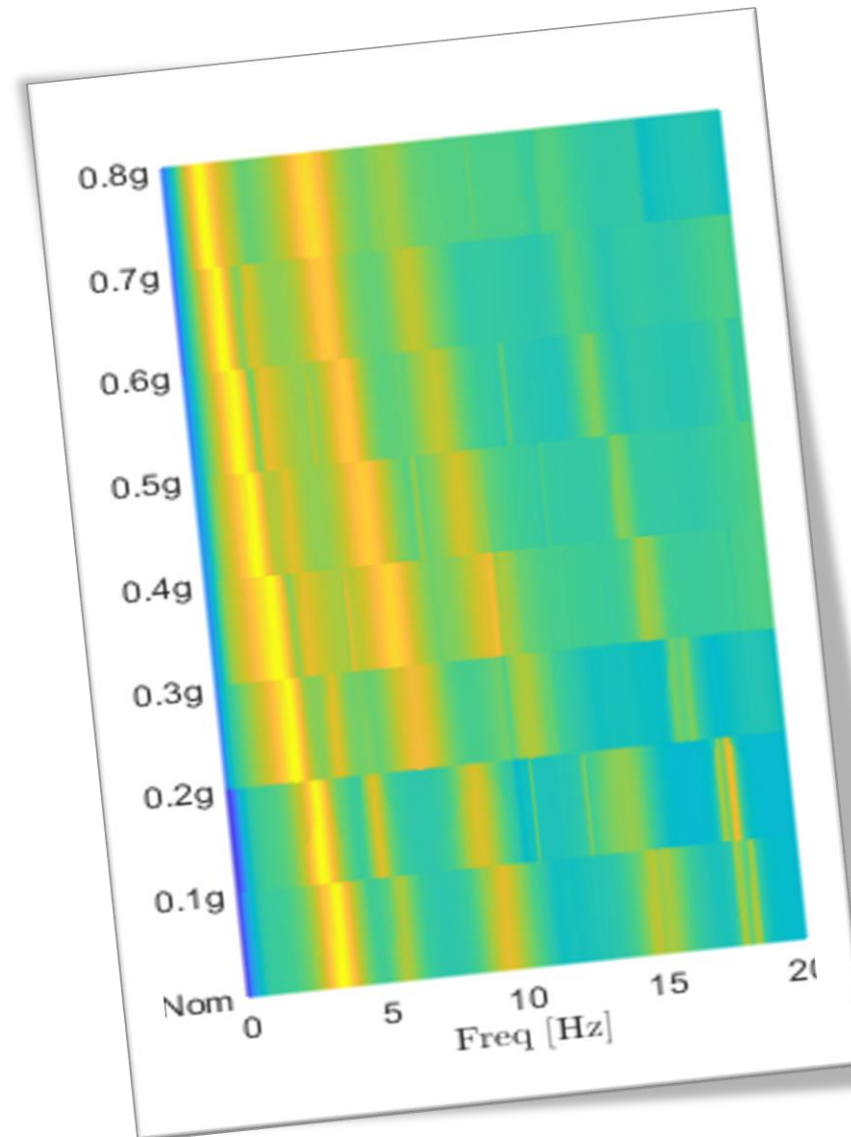
30 minuti, pressione 5 bars

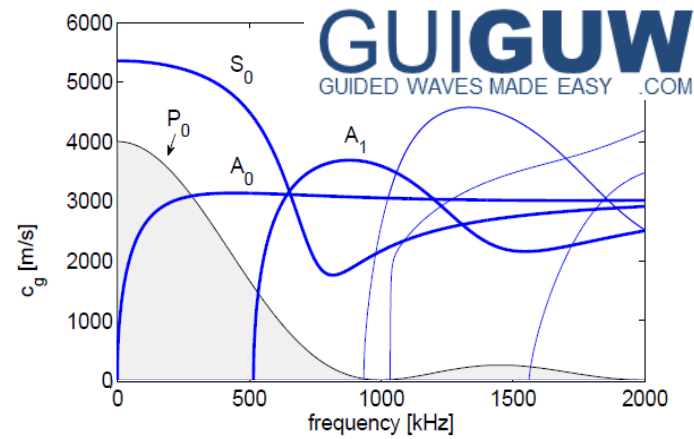
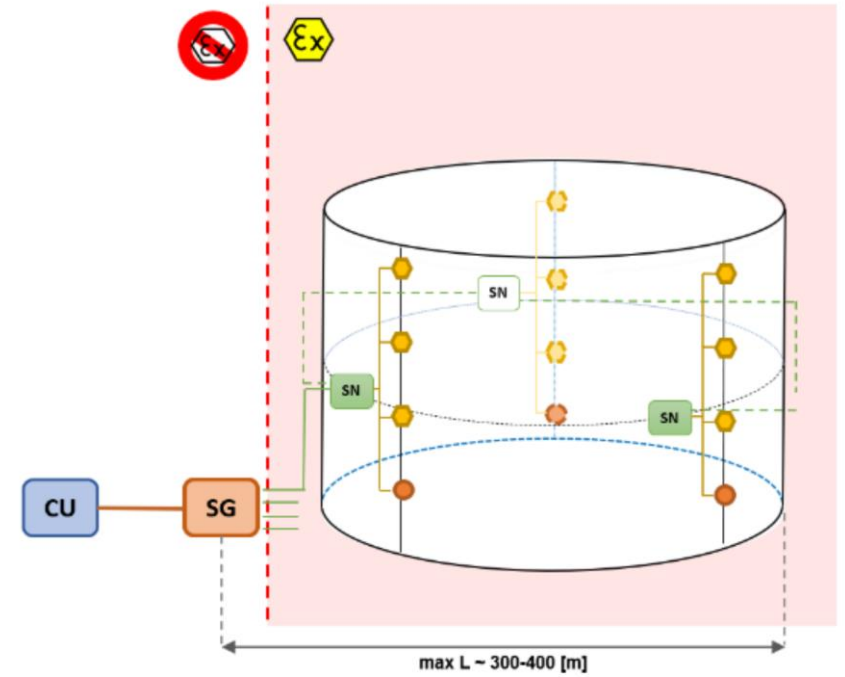
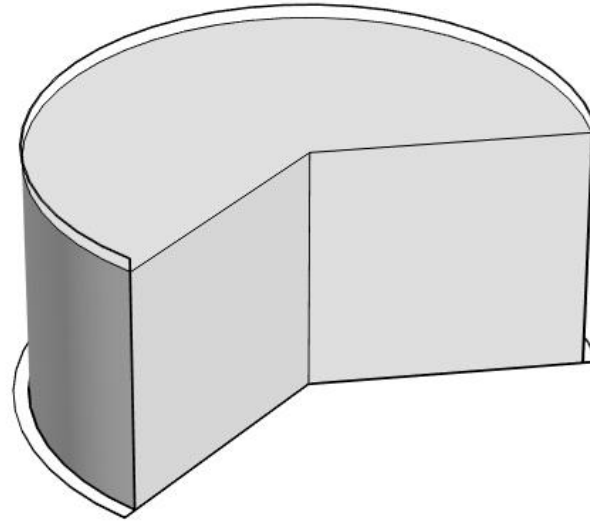


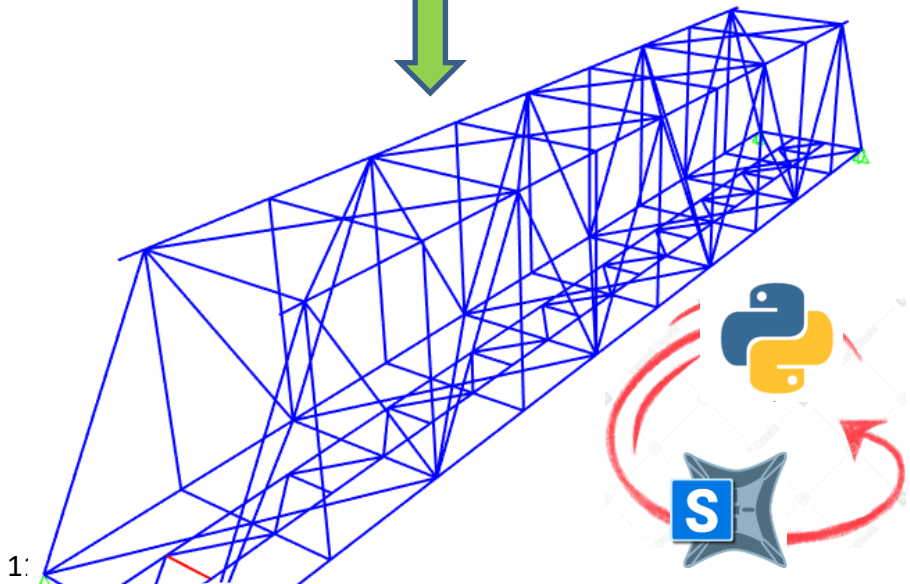


■ Elastic ■ Crack ■ Yield ■ Crushing Tens. Step:7994 (39.970)

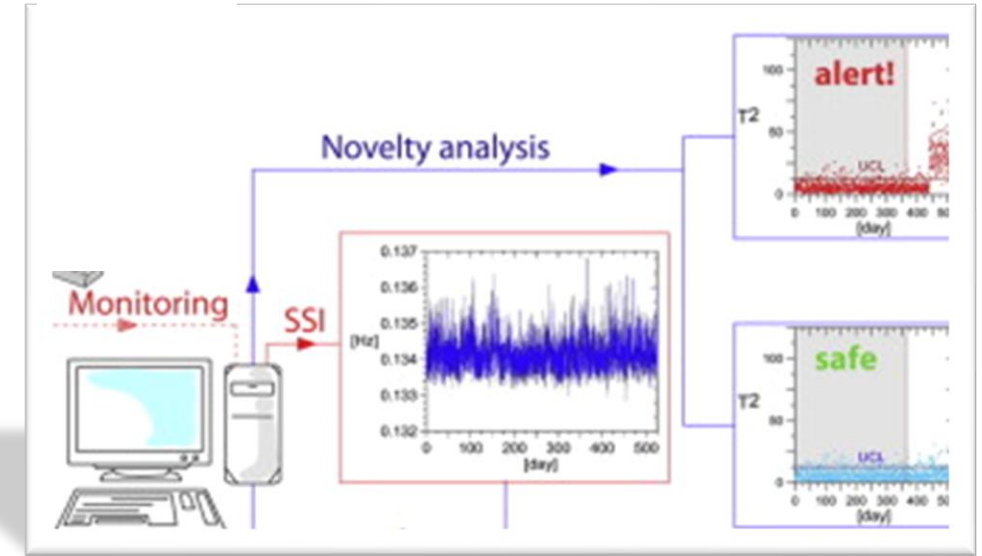




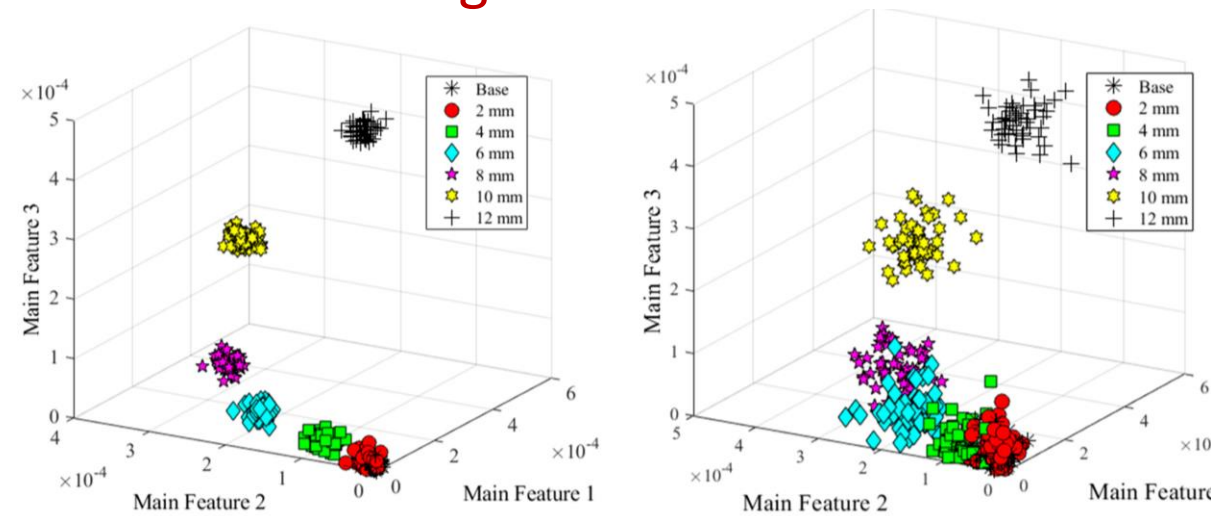




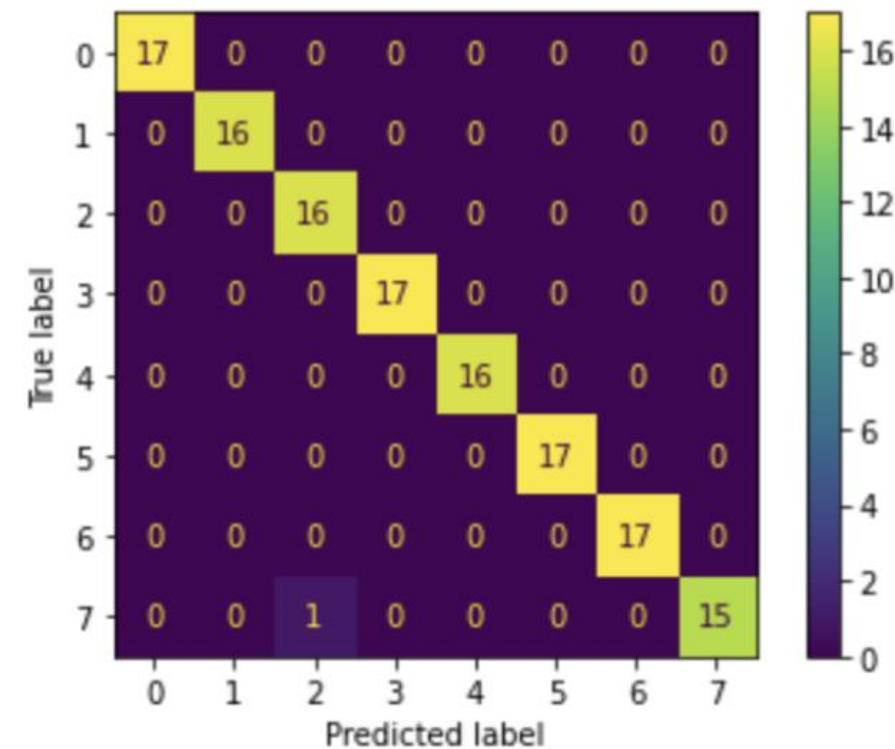
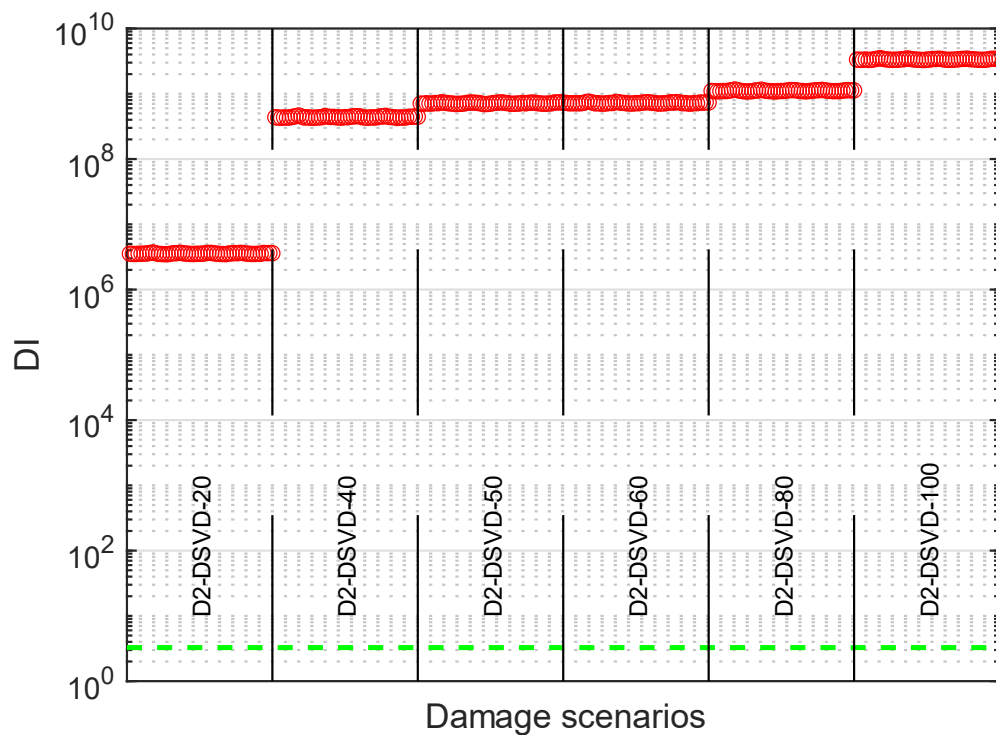
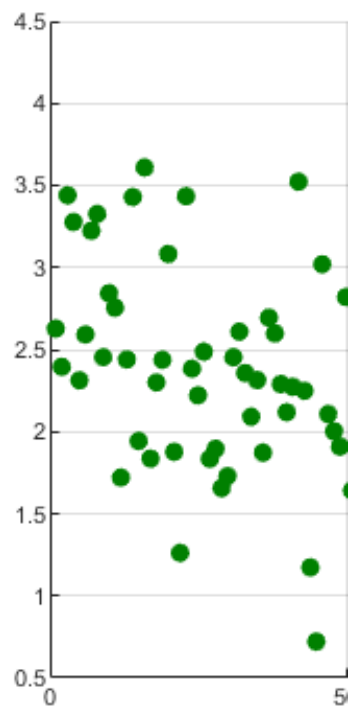
Anomaly detection



Damage classification



Anomaly detection	Damage classification		
Livello 1 Anomalia/danno SI/NO	Livello 2 Posizione	Livello 3 Tipo	Livello 4 Severità





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