

UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

**DOTTORATO DI RICERCA / PHD PROGRAM IN  
INFORMATION TECHNOLOGY AND ELECTRICAL ENGINEERING**

**Module Title: Matrix Analysis for Signal Processing with MATLAB Examples**

**Lecturer:**

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(DIETI)*

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*CV: Massimo Rosamilia received the B.S. (with honors) and M.S. degrees in computer engineering from the University of Salerno, Fisciano, Italy, in 2017 and 2019, respectively, and the Ph.D. degree (cum Laude) in information technologies and electrical engineering from the University of Naples Federico II, Naples, Italy, in 2023. In 2021 and 2022, he was a Visiting Ph.D Student with the Cranfield University, Shrivenham, U.K, and the University of Luxembourg, Luxembourg, respectively. He is currently a Researcher at the University of Naples Federico II. His research interest lies in the field of statistical signal processing, with emphasis on radar signal processing.*



The course is framed in the context of RESTART project, spoke 7, under the Italian National Recovery and Resilience Plan (NRRP) of NextGenerationEU, partnership on "Telecommunications of the Future" (PE00000001 - program "RESTART").



**Credits: 3**

## Overview

The course provides an overview on some topics in matrix theory together with their intrinsic interaction with and application to signal processing. The most important and "useful" tools, methods, and matrix structures are emphasized and complemented with MATLAB examples. The lectures cover basic matrix structures and operations, the concept of matrix norm, orthonormal matrices, Householder transformations, Givens rotation, QR factorization, singular value decomposition, positive (negative) semidefinite matrices and their eigenvalue characterization, Schur complement, Cholesky factorization, matrix gradient, least square problems, Kronecker product.

## Schedule

Lecture	Date	Time	Room	Topics
1	30/04/2024	15-17	Aula Seminari (ex Softel, 3 <sup>rd</sup> building, 1 <sup>st</sup> floor)	Basic matrix structures and operators. MATLAB examples.
2	02/05/2024	15-17	Aula Seminari (ex Softel, 3 <sup>rd</sup> building, 1 <sup>st</sup> floor)	Matrix norms. Orthonormal matrices, Matrix inverse. MATLAB examples.
3	07/05/2024	15-17	Aula Seminari (ex Softel, 3 <sup>rd</sup> building, 1 <sup>st</sup> floor)	Singular Value Decomposition. Quadratic forms and positive (negative) semidefinite matrices. MATLAB examples.
4	09/05/2024	15-17	Aula Seminari (ex Softel, 3 <sup>rd</sup> building, 1 <sup>st</sup> floor)	Schur complement. Cholesky factorization Eigenvalues and Eigenvectors. Matrix calculus. MATLAB examples.
5	14/05/2024	15-17	Aula Seminari (ex Softel, 3 <sup>rd</sup> building, 1 <sup>st</sup> floor)	Matrix Gradient. Least Square problems. Kronecker product. MATLAB examples.
6	21/05/2024	15-17	Aula Seminari (ex Softel, 3 <sup>rd</sup> building, 1 <sup>st</sup> floor)	Householder transformations. Givens rotation. QR factorization. MATLAB examples.
7	28/05/2024	15-17	Aula Seminari (ex Softel, 3 <sup>rd</sup> building, 1 <sup>st</sup> floor)	Exercises and assessment test

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