CONSORTIUM

2024-2026

Coordination
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Key words
Digital twin
Dynamic system
Metabolic networks
Microbial ecology

INRAE units involved
BioGeco
MaIAGE
LBE
Micalis
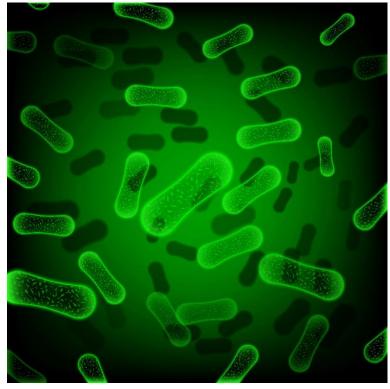ISA
MoSAR

Partnerships
Inria

Digital twins for microbial systems

The Arte-mis consortium will bring together an interdisciplinary community of researchers working at the interface between the experimental and digital sciences to overcome methodological barriers to the creation of digital twins in microbial ecology.

Context and challenges

Microbial ecology, which studies the place and role of micro-organisms within a given habitat (environment, ecosystem) and explores how they interact with one another and their environments, is a field of application particularly suited to modelling and the development of digital twins.

Indeed, a long history of reductionist approaches has allowed the development of controlled experimental systems that dynamically track reduced microbial communities known as synthetic communities, or syncoms. From these syncoms, an entire chain of modelling formalisms can be developed – the construction and exploration of metabolic networks, the prediction of metabolic fluxes, systems dynamics, monitoring, and optimisation. These models can be linked to temporal series for a variety of omics data, such as population densities, metabolomics, or meta-transcriptomics data.

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Metaprogramme
DIGIT-BIO

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Goals

To promote reflection on the use of digital twins in microbial ecology, the Arte-mis consortium will bring together an interdisciplinary group of researchers with experience in digital and mathematical or experimental methods, who are interested in the interactions between experimental systems and digital artifacts that occur throughout the life cycle of experimentation and modelling.

Project directions will be developed from a first reflective workshop. This will identify the methodological obstacles and opportunities relating to the development of digital twins in microbial ecology and will explore promising fields of application.

Seminar series covering the various fields identified in the workshop will then be set up and will allow the mapping of a national and international community of scientists with a shared interest in the use of digital twins in microbial ecology.

Last, an opinion paper synthesizing these reflective activities will allow the development of more targeted future projects on possible applications in microbiology.

Research units involved and partnerships

INRAE scientific division	INRAE research units	Expertises
Mathematics and Digital Technologies	BioGeco	Modelling, systems dynamics, EDP
	MaIAGE	Modelling, systems dynamics, EDP, metabolic networks
Microbiology and the Food Chain	LBE	Modelling, experimentation, environmental bio-processes
	Micalis	Culturomics, microbiology, imaging, biofilms, systems biology
Agroecosystems	ISA	Modelling, systems dynamics
Animal Physiology and Livestock Systems	MoSAR	Modelling, systems dynamics, bioprocesses, rumen
External partners		Expertises
Inria	Pleiade team	Modelling, systems dynamics, metabolic networks, digital biology
	MACBES team	Systems dynamics, modelling, monitoring