EXA Group
Energy and Environmental Simulation

PPGCIS
Programa de Pós-Graduação em Cidades Inteligentes e Sustentáveis

PPGEM
Programa de Pós-Graduação em Engenharia Mecânica

IEA-EBC Anexo 60
Simulação Avançada de Desempenho Energético de Edificações

Participação brasileira no Anexo 60 da Agência Internacional de Energia (IEA) 2012-2017

Walter Mazuroski
Luciano Mello
Gustavo Cherem Pereira
Santiago Riquelme
Nathan Mendes (coordenador)

Curitiba, 6 de Agosto de 2025

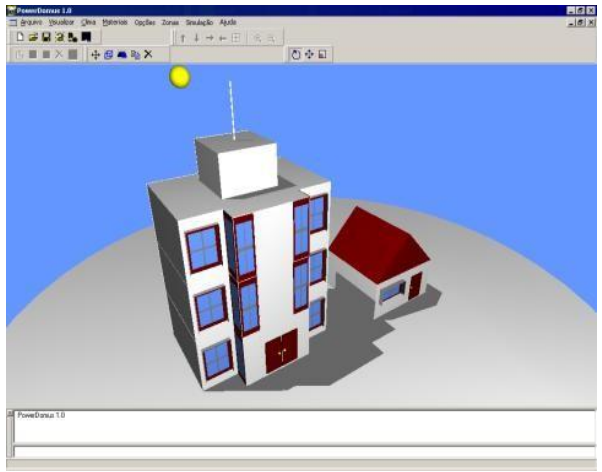
CAPES
COFECUB
FUNDAÇÃO ARAUCÁRIA
ENBPar Empresa Brasileira de Participações em Energia Nuclear e Binacional
MINISTÉRIO DE MINAS E ENERGIA
PÁTRIA AMADA BRASIL GOVERNO FEDERAL

Conteúdo

- Contextualização
- Panorama do Anexo 60
- Produtos
- Publicações
- Perspectivas

PPGCIS

PPGEM



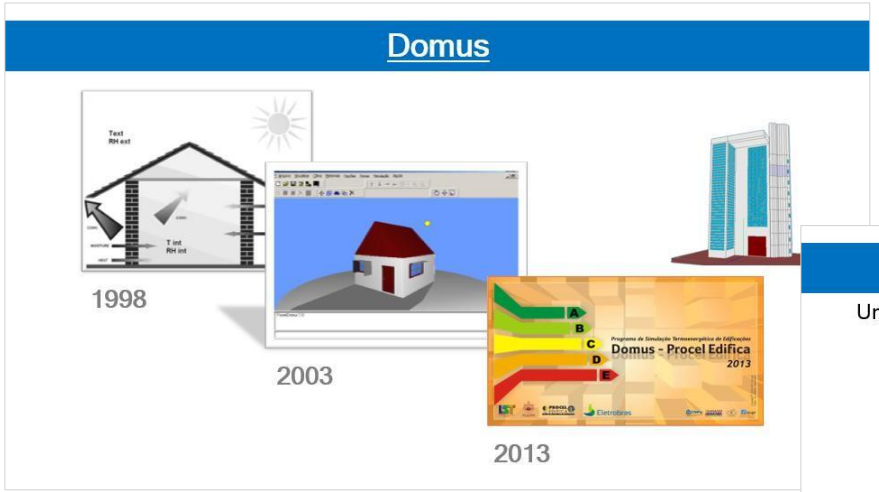
Contextualização

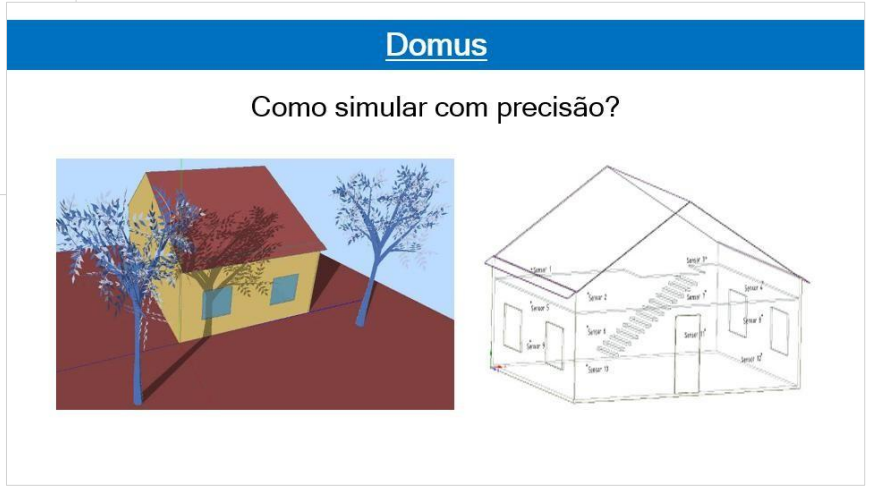
Alguns dos Anexos da IEA dos quais a PUCPR participou:

Annex 41 (2003-2007)

Annex 55 (2010-2015)

Annex 60 (2012-2017)





Panorama do Anexo 60

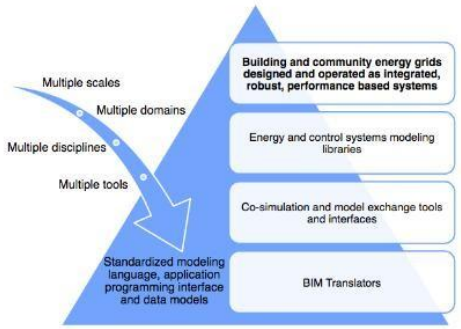
www.iea-annex60.org

IEA EBC Annex 60

Energy in Buildings and Communities Programme

Home | About | Publications | News | Participants index

New generation computational tools for building and community energy systems based on the Modelica and Functional Mockup Interface standards



Annex 60 overview.

The objectives of Annex 60 are to develop and demonstrate next-generation computational tools that allow building and community energy grids to be designed and operated as integrated, robust, performance based systems.

Annex 60 will share, further develop and deploy free open-source contributions of currently uncoordinated activities in modeling and simulation of energy systems of buildings and communities, based on the Modelica and Functional Mockup Interface standards. The project will create and validate tool-chains that link Building Information Models to energy modeling, building simulation to controls design tools, and design tools to operational tools. Invention and deployment of integrated energy-related systems and performance-based solutions for buildings and communities will be accelerated by extending, unifying and documenting existing Modelica libraries and by linking existing building performance simulation tools with Modelica through the Functional Mockup Interface standard. The technology will allow optimized design, analysis and operation of multi-domain systems as posed by building and community energy systems. It will also allow using models across the whole building life cycle to ensure realization and persistence of design intent.

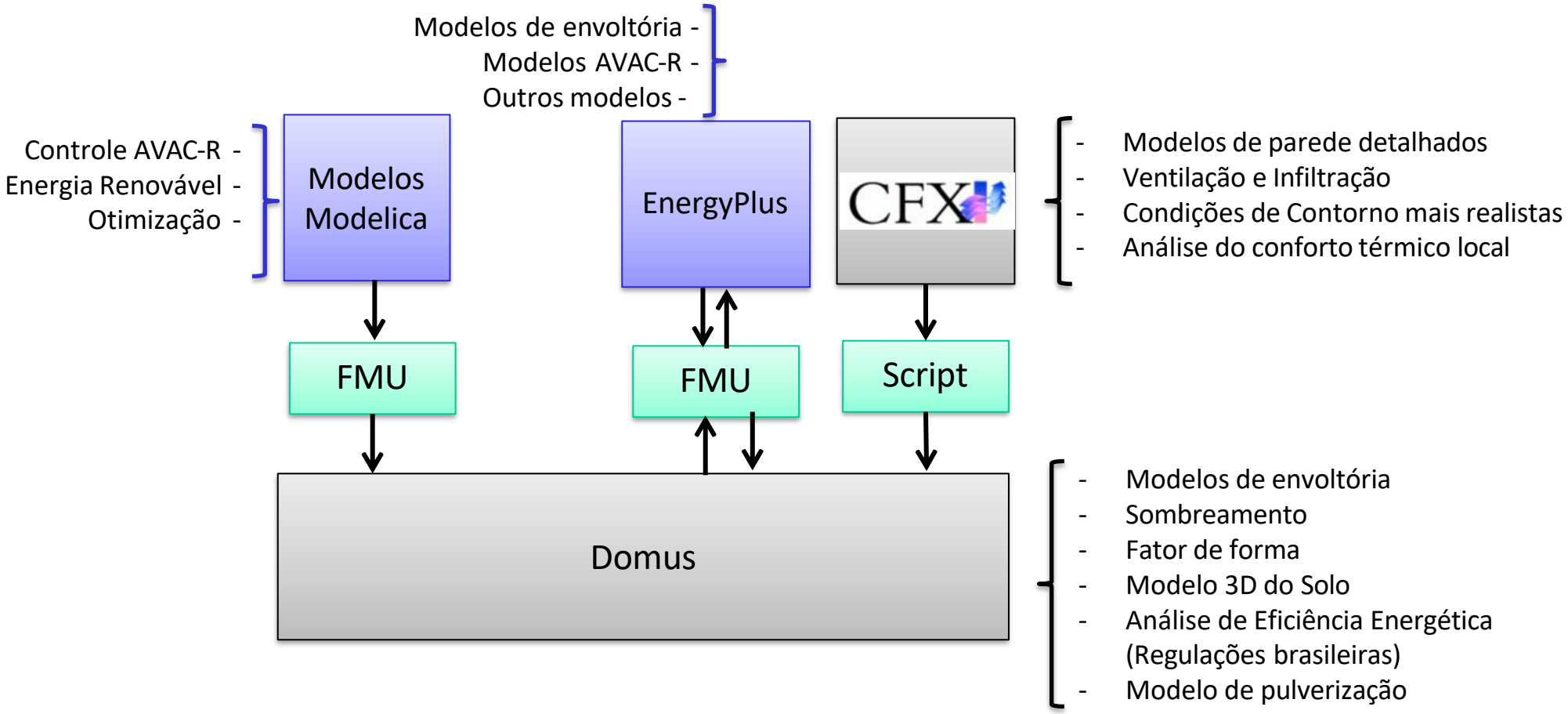
News

- September 2017: The final report of Annex 60 has been published.
- August 2017: Annex 60 is now continued as IBPSA Project 1.
- January 2017: Modelica Annex 60 library released.
- October 2016: GENSIM Scientific School slides posted.
- May 2016: Draft workplan and registration form for IBPSA Project 1 posted.
- May 2016: 6th expert meeting of research phase.
- December 2015: IBPSA Board approved continuation of Annex 60.

Duração: 2012-2017 (continuado como IBPSA Project 1, 2017-2022)

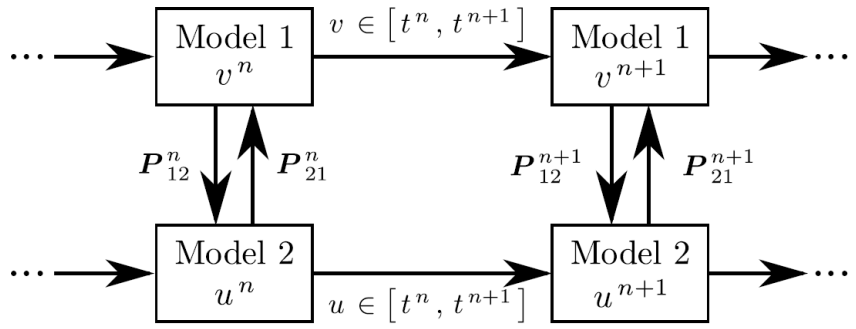
Produtos

Domus & Co-Simulações

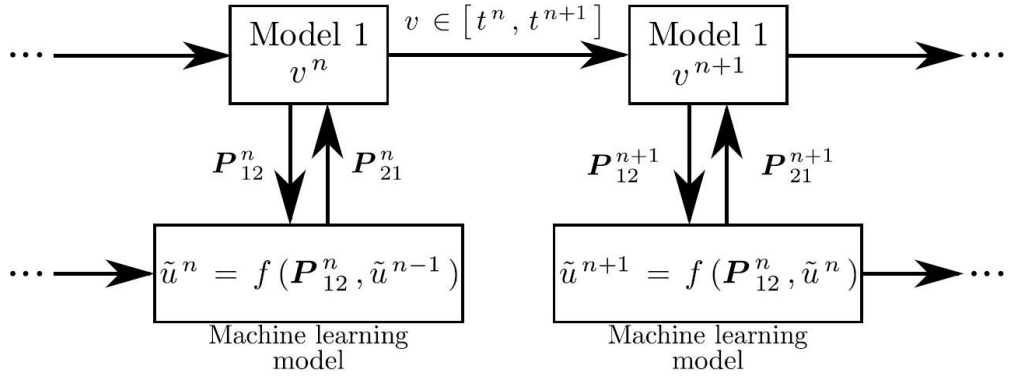


Produtos

Co-simulação Inteligente



(a) Classic co-simulation



(b) Intelligent co-simulation

Fase de Treinamento

- Executa a co-simulação em sua configuração padrão
- Elabora um modelo de predição

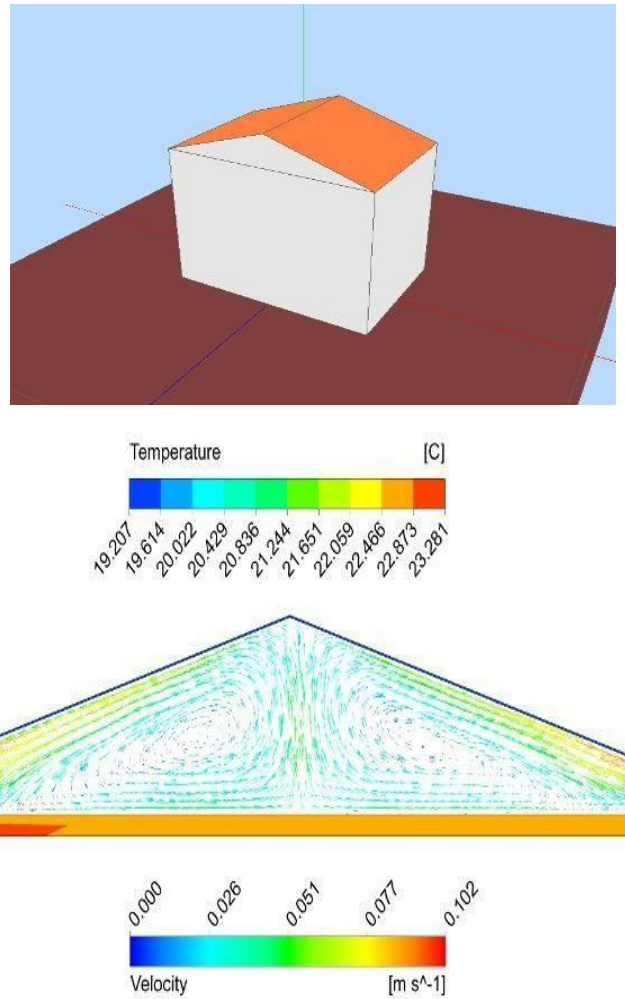
Fase de Predição

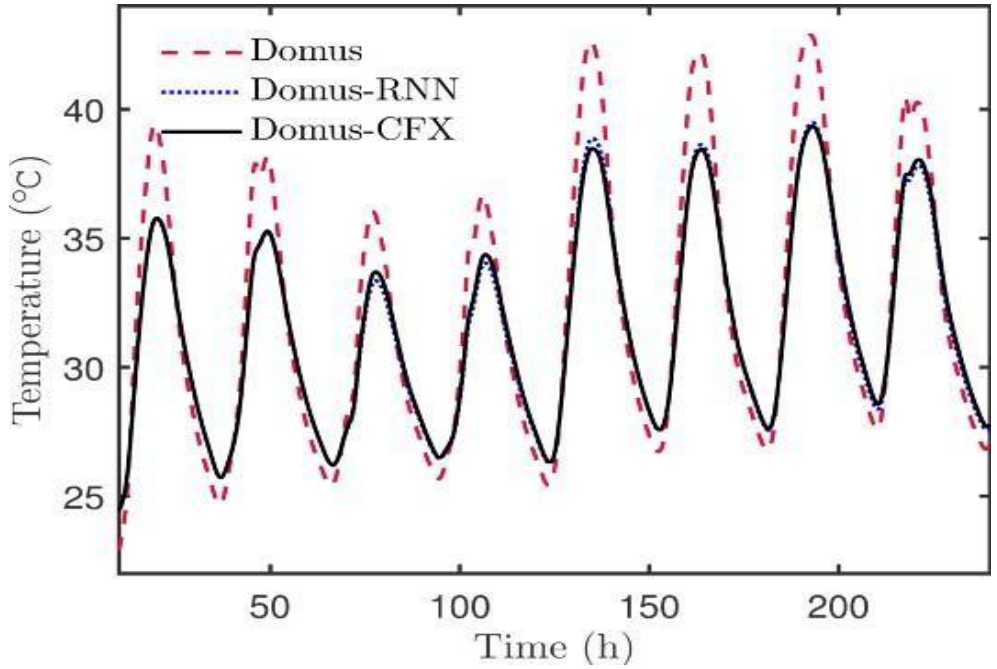
- Desabilita a ferramenta integrada à co-simulação
- Utiliza o modelo de predição

Mazuroski (2018)

Produtos

Resultados aplicando a co-simulação inteligente

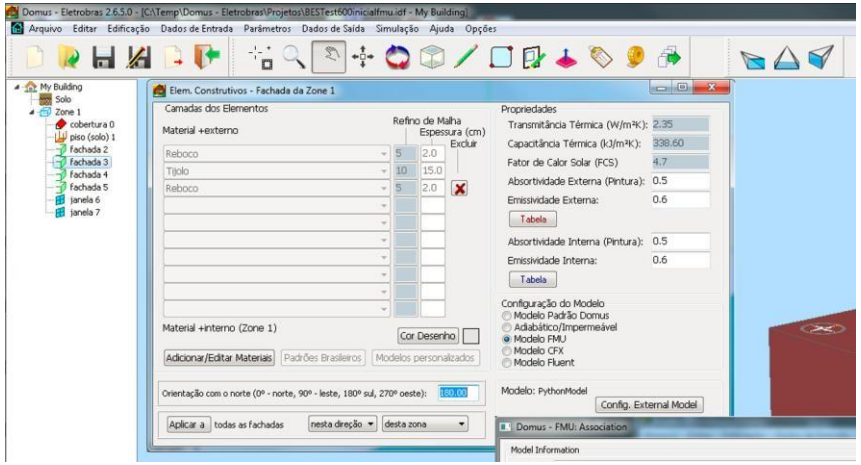


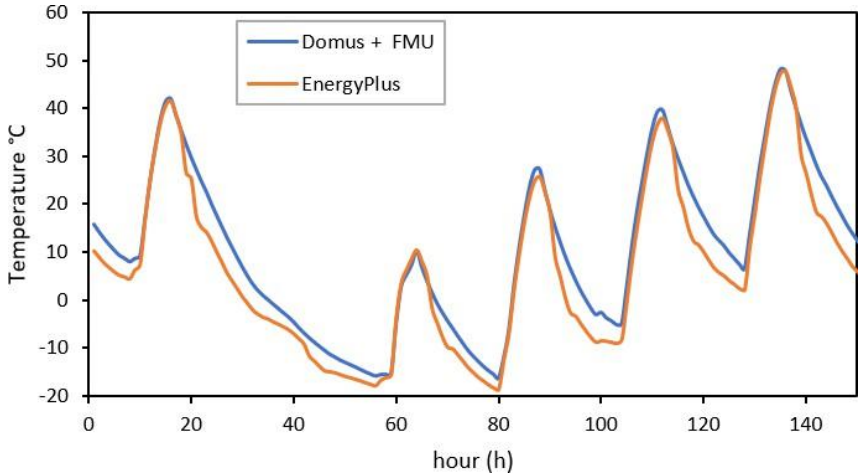


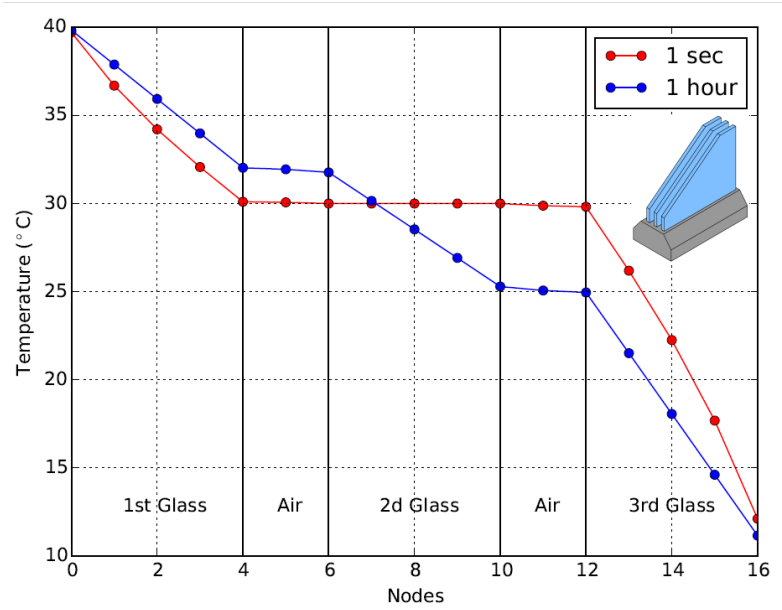
- Apenas o modelo mostra uma diferença de 4,2°C
- Modelo RNN apresenta um erro 10 vezes menor
- Máxima diferença de apenas 0,4°C

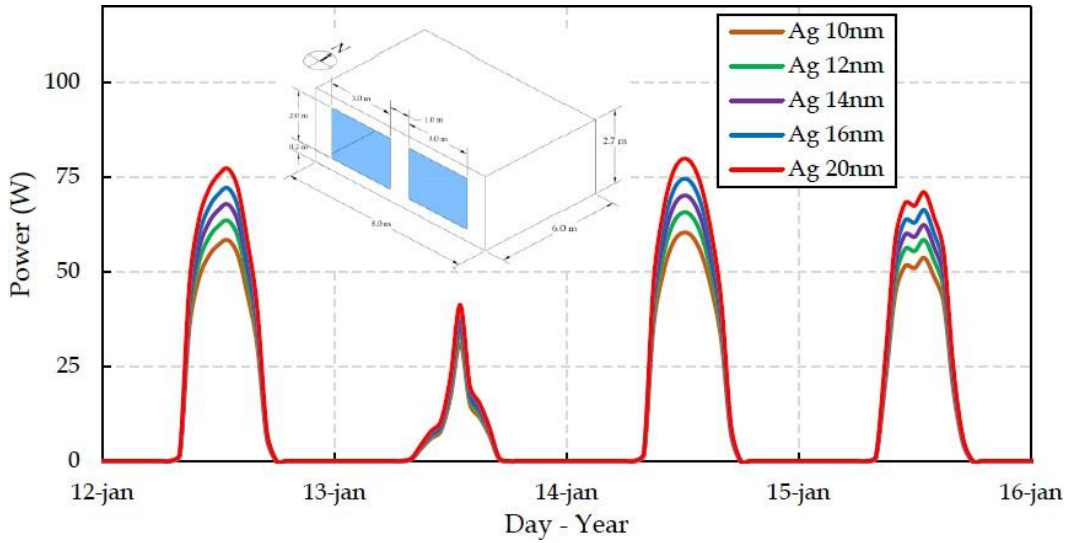
Produtos

Domus FMU Janela



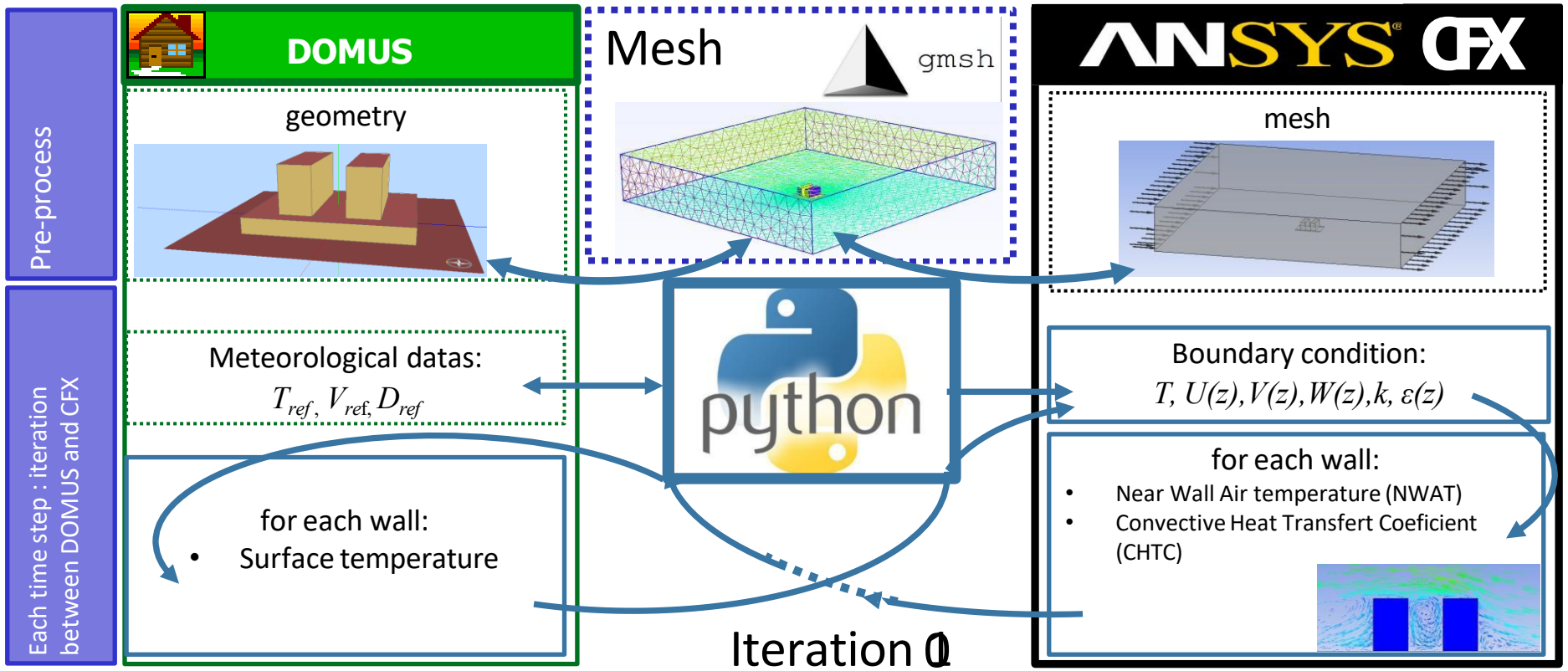






Produtos

Escoamento externo com Domus-CFX

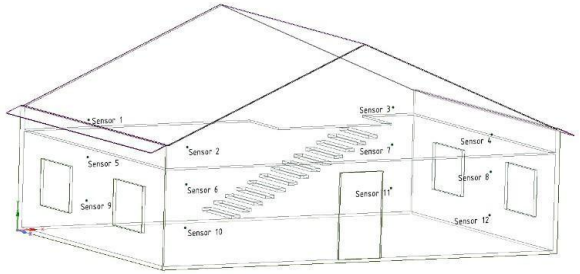


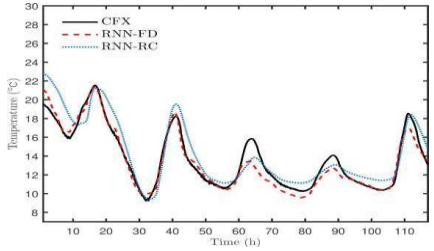
By Dr. Adiren Gros

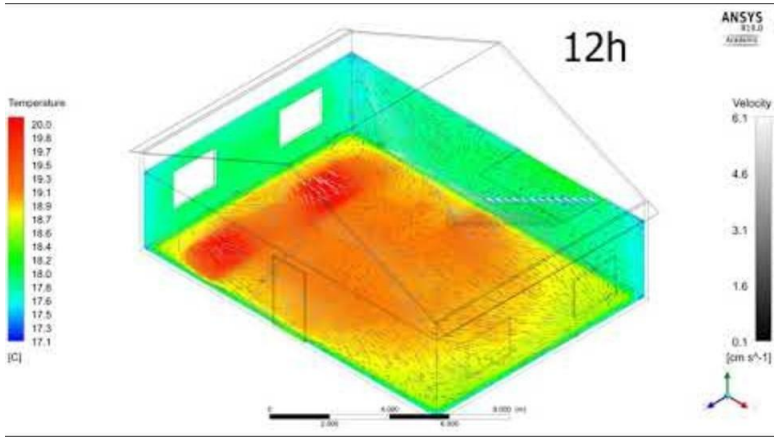
Produtos

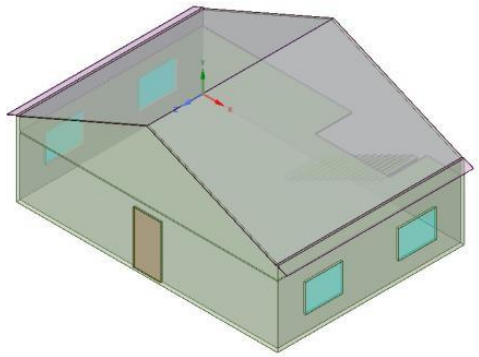
Escoamento interno com Domus-CFX & condições de contorno complexas

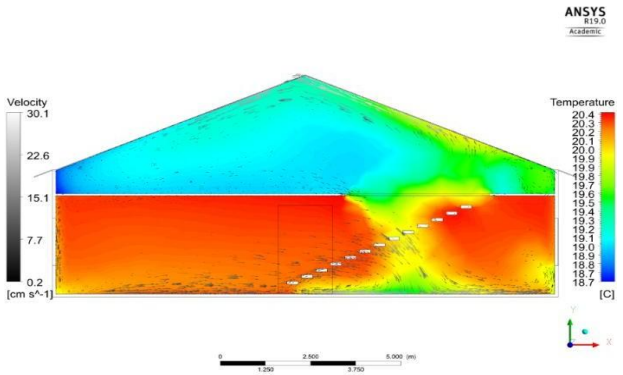
- Co-simulação para disponibilizar os fluxos de radiação direta, difusa e refletida, além da região ensolarada.
- Superfícies internas e externas.
- Considerando com precisão os sombreamentos complexos por meio da técnica de contagem de pixels (PxC).

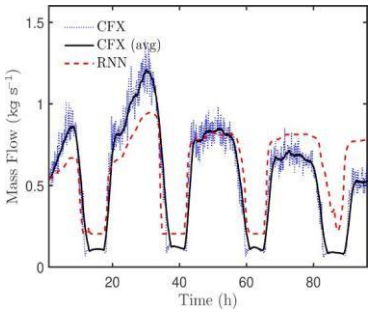








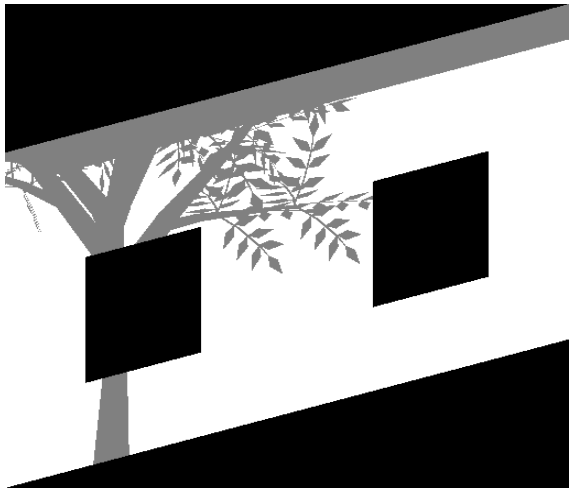


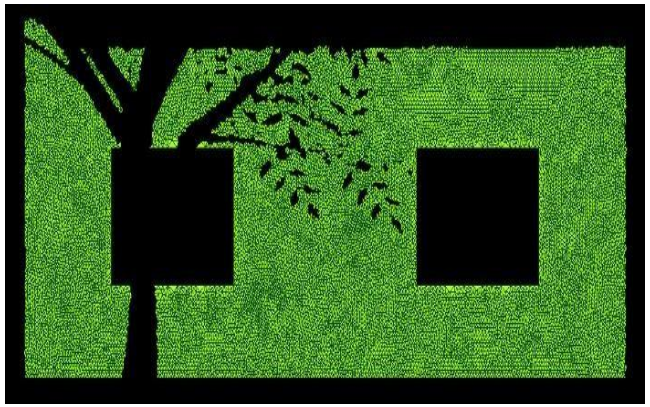


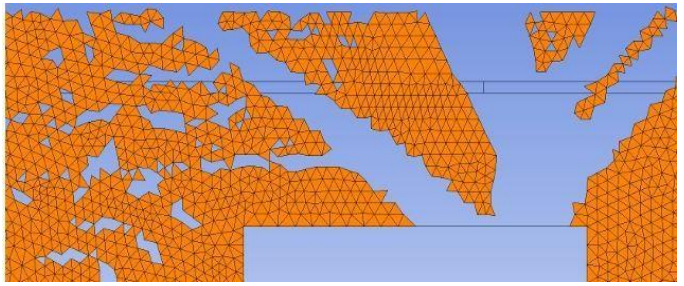
Vídeo: https://www.youtube.com/watch?v=q0PFc8HlkXw

Produtos

Domus PxC → Simulação CFD







Localizar as faces da malha que sejam coincidentes
com os pontos PxC nas coordenadas do sistema global.

Publicações

Applied Energy
Volume 190, 15 March 2017, Pages 266-277

An innovative method for the design of high energy performance building envelopes

Julien Berger, Nathan Mendes

Show more

+ Add to Mendeley Share Cite

https://doi.org/10.1016/j.apenergy.2016.12.119 Get rights and content

Articles

Intelligent co-simulation: neural network vs. proper orthogonal decomposition applied to a 2D diffusive problem

Julien Berger, Walter Mazuroski, Ricardo C.L.F. Oliveira & Nathan Mendes

Pages 568-587 | Received 25 Aug 2017, Accepted 05 Dec 2017, Published online: 06 Feb 2018

Cite this article https://doi.org/10.1080/19401493.2017.1414879 Check for updates

Home > Journal of the Brazilian Society of Mechanical Sciences and Engineering > Article

An innovative method to determine optimum insulation thickness based on non-uniform adaptive moving grid

Technical Paper | Published: 14 March 2019

Volume 41, article number 173, (2019) Cite this article

Download PDF Access provided by Pontifícia Universidade Catolica do Parana PUC-PR

Suelen Gasparin, Julien Berger, Denys Dutykh & Nathan Mendes

213 Accesses 13 Citations 1 Altmetric Explore all metrics

Edição especial ENCAC • Ambient. constr. 18 (3) • Jul-Sep 2018 • https://doi.org/10.1590/s1678-86212018000300269 copy

Open-access Domus method for predicting sunlit areas on interior surfaces

Método para previsão das áreas ensolaradas em superfícies internas implementado no software Domus

Authorship SCIMAGO INSTITUTIONS RANKINGS

Articles

An artificial intelligence-based method to efficiently bring CFD to building simulation

Walter Mazuroski, Julien Berger, Ricardo C. L. F. Oliveira & Nathan Mendes

Pages 588-603 | Received 02 Aug 2017, Accepted 05 Dec 2017, Published online: 12 Jan 2018

Cite this article https://doi.org/10.1080/19401493.2017.1414880 Check for updates

BS 2019 16th IBPSA International Conference and Exhibition ROME INTERNATIONAL BUILDING PERFORMANCE SIMULATION ASSOCIATION

BESP: An Integrated Artificial Intelligence-Based Platform for Building and Environment Simulation

Walter Mazuroski[1], Ricardo C.L.F de Oliveira[2], Nathan Mendes[1]
[1] PUCPR/PPGEM/LST, Pontifical Catholic University of Parana, Curitiba, PR, Brazil
[2] School of Electrical and Computer Engineering, University of Campinas, Campinas, SP, Brazil

Solar Energy
Volume 184, 15 May 2019, Pages 173-186

A pixel counting technique for sun patch assessment within building enclosures

Ana Paula de Almeida Rocha [a], Auline Rodler [b], Ricardo C.L.F. Oliveira [c], Joseph Virgone [d], Nathan Mendes [a]

Show more

+ Add to Mendeley Share Cite

https://doi.org/10.1016/j.solener.2019.03.081 Get rights and content

Applied Energy
Volume 262, 15 March 2020, 114497

A pixel counting based method for designing shading devices in buildings considering energy efficiency, daylight use and fading protection

Ana Paula de Almeida Rocha [a c], Gilberto Reynoso-Meza [a], Ricardo C.L.F. Oliveira [b], Nathan Mendes [a]

Show more

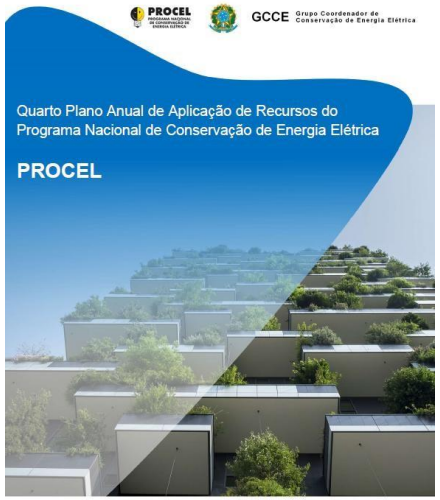
+ Add to Mendeley Share Cite

https://doi.org/10.1016/j.apenergy.2020.114497 Get rights and content

Perspectivas

PAR-PROCEL IV & ANEXO 97 da IEA (em desenvolvimento)

PAR-PROCEL IV
A importância da eficiência energética em edificações para mitigação de riscos relacionados a problemas de ilhas de calor urbano



4º PAR PROCEL 2022/2023

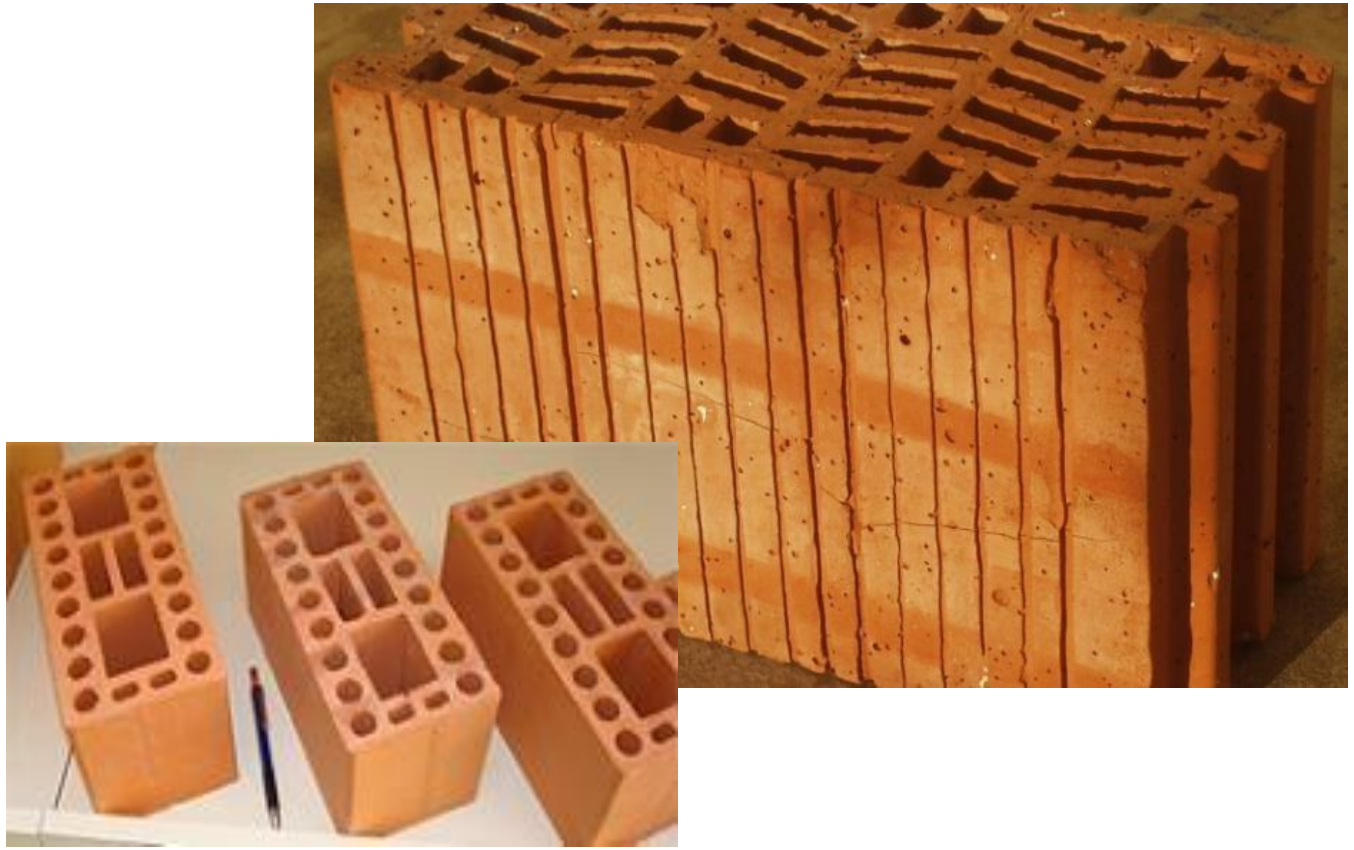
ANEXO 97 da IEA
Resfriamento Sustentável em Cidades

Perspectivas

Potencialidades

- Incentivo à pesquisa de novos elementos construtivos, analisando seu comportamento transitório

- Tijolos
- Telhados
- Camadas de ar
- Janelas
- Paredes complexas
- Sistemas de climatição
- etc



Perspectivas

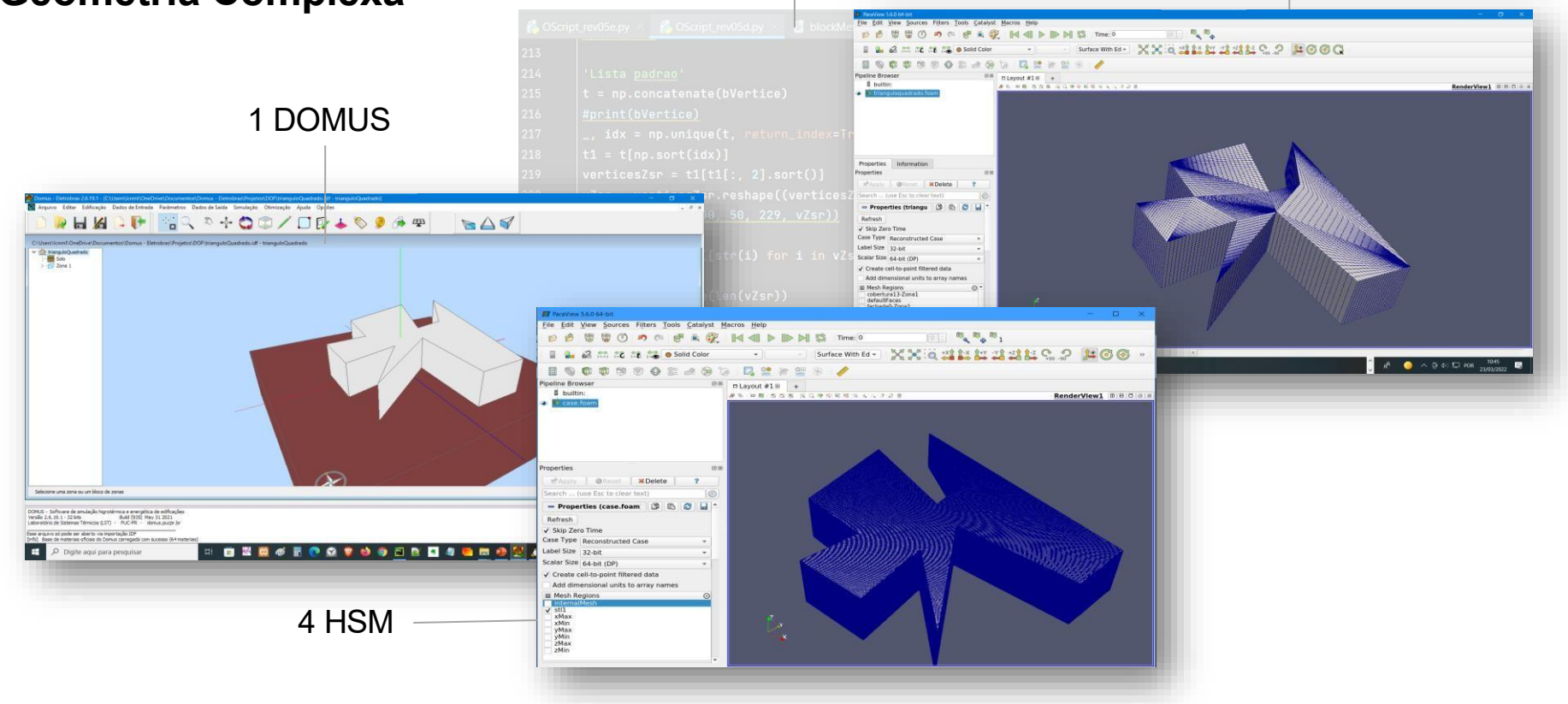
Co-simulação Domus-OpenFoam (em fase de testes)

Geometria Complexa

2 Script (Python)

3 BlockMesh

1 DOMUS

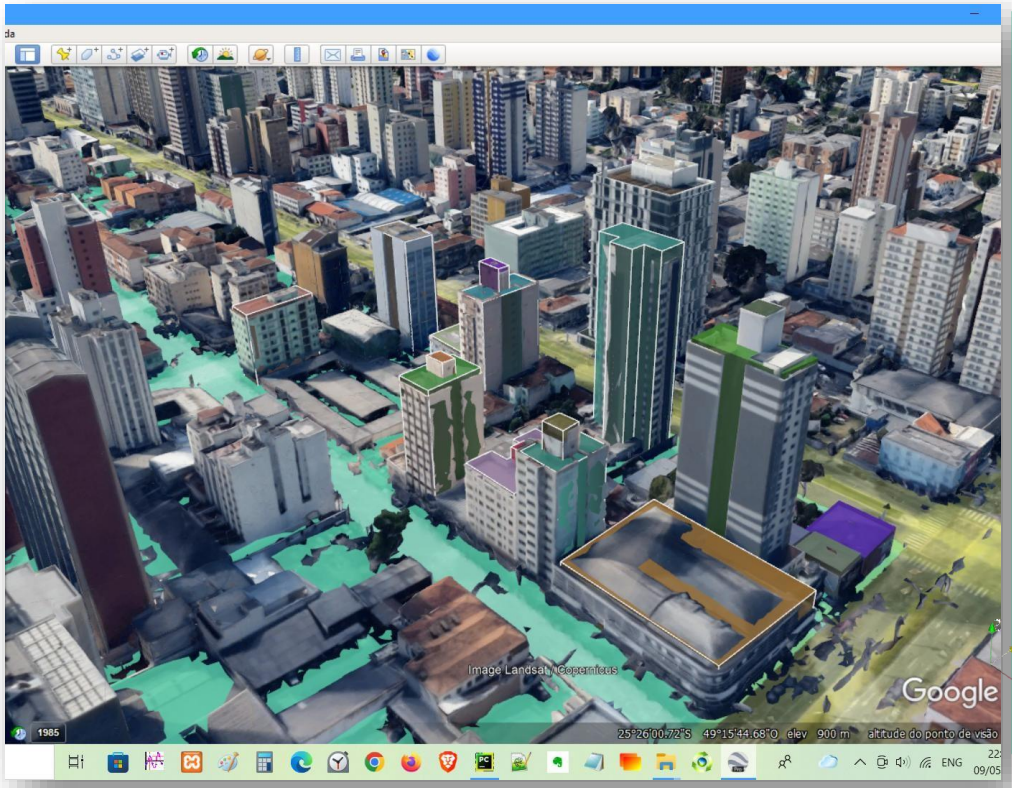


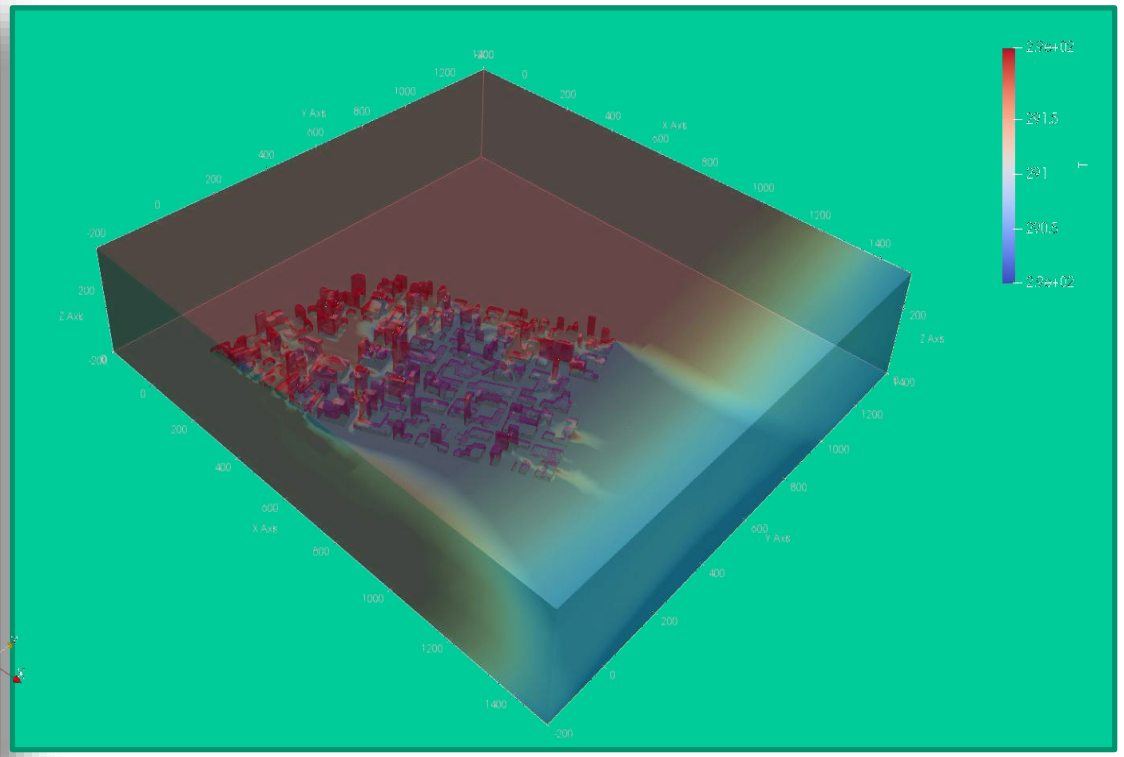
4 HSM

Perspectivas

Co-simulação Domus-OpenFoam para escoamento externo (em fase de testes)

1 Google Earth Pro

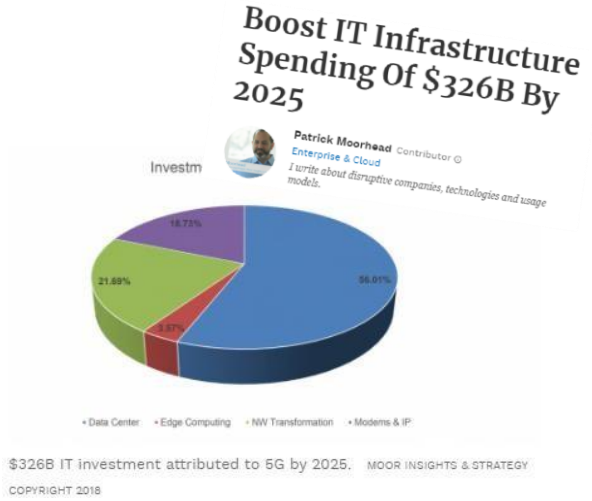




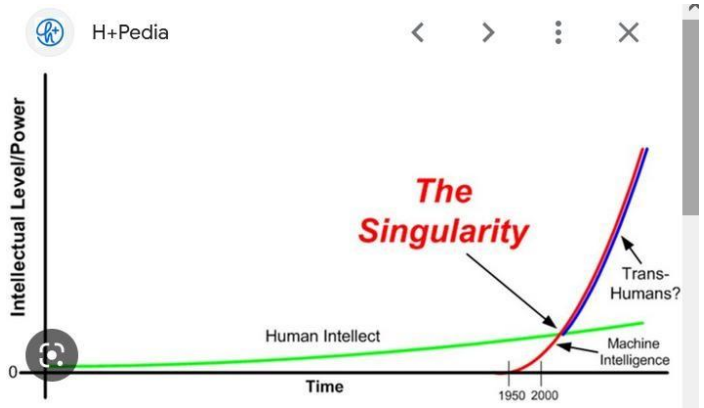
Perspectivas

Considerações Finais

IA
Cloud computing
IoT
Cyber Systems



- Nova era da simulação
- Escala urbana (PAR-Procel IV)
- *IA-based Integrated multiphysics platform*
- *Hardware/Sensor-in-the-loop simulation*
- *Reinforcement learning*
- *Self-communicating tools*
- ...



Muito obrigado

PPGCIS
Programa de Pós-Graduação em Cidades Inteligentes e Sustentáveis

PPGEM
Programa de Pós-Graduação em Engenharia Mecânica

EXA Group
Energy and Environmental Simulation

Dúvidas?

EXA Group
exa@pucpr.br