Sound synthesis and practical applications of robotics simulations

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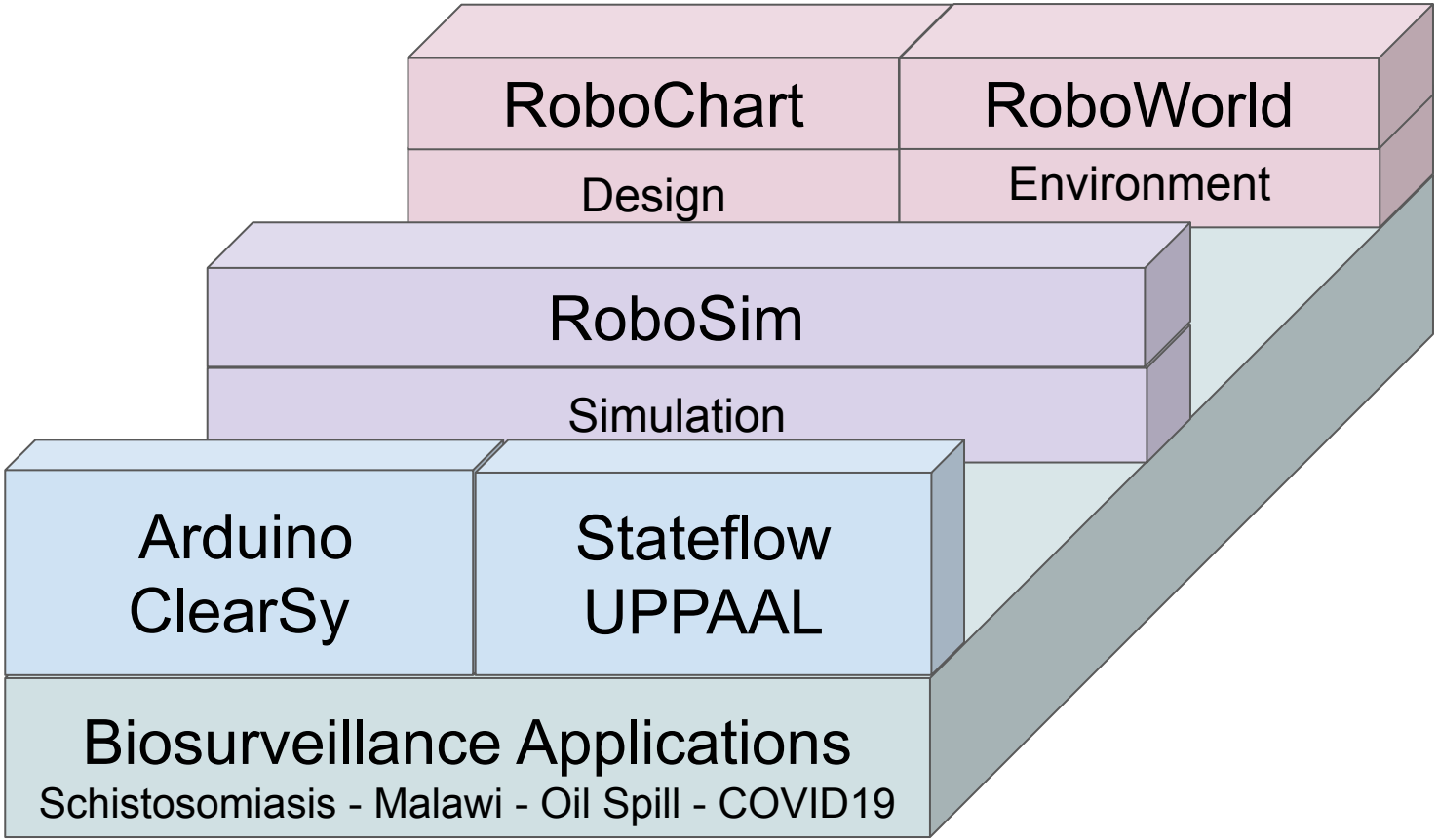
8th INES Workshop - 04 December 2020

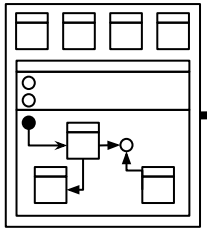
OBJECTIVE

The main objective of this project is to **create a systematic and rigorous methodology to specify, verify, design and implement robotic applications. It is part of the RoboStar initiative (https://www.cs.york.ac.uk/RoboStar/).** The focus is on the design of a graphical simulation language, RoboSim, and mapping models in RoboSim to several target platforms: Arduino, B, and Simulink/Stateflow, among others. The development of the final implementations from the simulations is also in scope. The aim is to extend this scope with facilities for simulation and implementation of robot applications.

Approach overview



The Artifacts



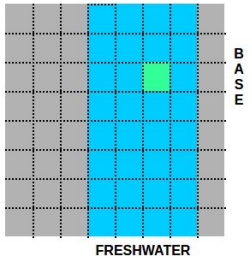
RoboChart

```
void
run_state_machine
() {
  switch(state) {
    case state1:
      state1();
      break;
    case state2:
```

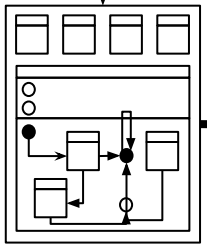
Test Cases

```
ne() {
  switch(state) {
    case state1:
      state1();
      break;
    case state2:
      state2();
      Break;
```

RoboWorld Assumptions



Environment Model



RoboSim

```
void
run_state_machine
() {
  switch(state) {
    case state1:
      state1();
      break;
    case state2:
```

Arduino | ClearSy | Simulink | UPPAAL

```
OK!
NOT OK!
```

Model Checking

Professores

Adolfo Duran	PhD	UFBA
Alexandre Mota	PhD	UFPE
Álvaro Miyazawa	PhD	York
Ana Cavalcanti	PhD	York
Augusto Sampaio	PhD	UFPE
Daniel Lopez-Codina	PhD	UPC
Gustavo Carvalho	PhD	UFPE
Jim Woodcock	PhD	York
Jon Timmis	PhD	York
Jones Albuquerque	PhD	UFRPE
Juliano Iyoda	PhD	UFPE
Madiel Souza Conserva Filho	PhD	UFPE
Marcel Vinicius Medeiros Oliveira	PhD	UFRN
Marcio Cornélio	PhD	UFPE
Pedro Ribeiro	PhD	York
Sidney Nogueira	PhD	UFRPE
Silvana Bocanegra	PhD	UFRPE
Thierry Lecomte	PhD	Clearsy

Bolsistas

William Bocanegra	BCT-0358-1.03/19	BCT-10
Vinicius Vilaça	BCT-0357-1.03/19	BCT-10
Edneide Florivalda Ramos Ramalho	CAPES 081.818.434-5	PosDoc
Rayanna Barroso de Oliveira Alves	BCT-0270-1.03/19	BCT-07
Matheus Alves Almeida	BCT-0063-1.03/20	BCT-10
Erico Andre da Silva	BCT-0062-1.03/20	BCT-10
Marina Collares Fernandes	BCT-0177-1.03/20	BCT-10
André Victor de Albuquerque Araújo	BCT-0178-1.03/20	BCT-10
Joana Maria Cassemiro Assunção	BCT-0179-1.03/20	BCT-10
Eduardo Barradas Mendonça	BCT-0208-1.03-20	BCT-06

Madiel Souza Conserva Filho	PhD	UFPE
Flavio Ramos	MSc	UFPE

Mingzhuo Zhang	MSc	ECNU
Paulo Cesar Marques	PhD	UFRPE
Rajneesh Menezes	PIBIC	UFRPE

PARTNERSHIPS - Other Projects

Indoor - INES

1. Improving the Energy Efficiency of Android Mobiles Applications - UFPE
   Must be :-)
   Towards an Evaluation and Support Platform for Conducting Empirical Studies and Creating Testbeds - UFPE
   ADApt – Abordagem para Desenvolvimento e Avaliação de Aplicações no Ambiente de Cidades Inteligentes - UFC

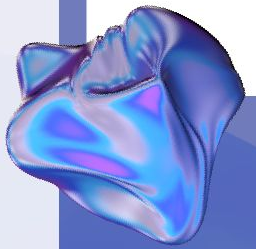
Outdoor - INES

1. https://www.cs.york.ac.uk/circus/RoboCalc/
2. https://www.ucl.ac.uk/risk-disaster-reduction/
3. https://biocomsc.upc.edu/en
4. https://www.irrd.org/
5. https://www.ufpe.br/lika

ROBOTIC@ results

Applications on Biotech

III SEMINÁRIO DE AVALIAÇÃO DOS INSTITUTOS NACIONAIS DE CIÊNCIA E TECNOLOGIA



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CNPq

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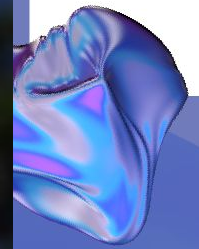
PÁTRIA AMADA BRASIL GOVERNO FEDERAL

III SEMINÁRIO DE AVALIAÇÃO DOS INSTITUTOS NACIONAIS DE CIÊNCIA E TECNOLOGIA



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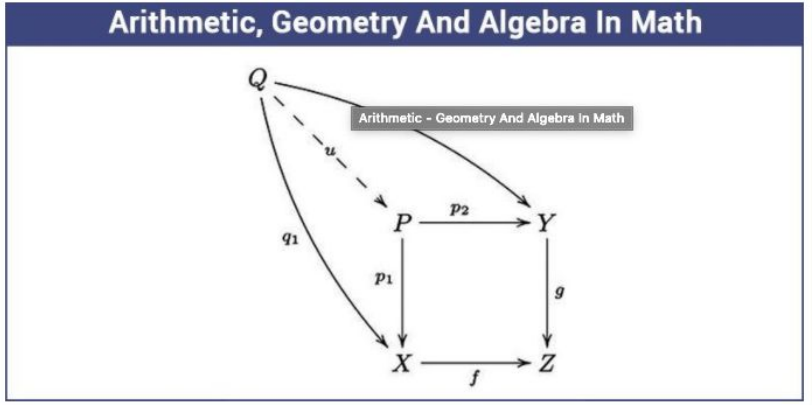
Fundamentals

Turing Machines are on Algebraic abstractions (u-recursive functions) to compute Arithmetic (computable numbers)

Our Applications are on Geometric Abstractions (Leibniz Machina) to compute Algebras



Basics of Mathematics

Here, we are going to discuss the four basic components of Mathematics here in detail with examples. Go through the below article and get to know about the uses of these components.

Arithmetic – Numbers and Operations

This is where Mathematics began, the first method of counting was counting on fingers. This evolved into sign language for the hand-to-eye communication of numbers. Tallies made by carving notches in wood, bone, and stone were used for at least forty thousand years, post this we started to count. Then came numbers.

The branch of mathematics dealing with the properties and manipulation of numbers is called Arithmetic. You are already familiar with all the arithmetic operations: Addition (+), Subtraction (-), Multiplication (*) and Division (/). Other concepts like powers, roots, logs, exponents etc.exist but all of them are just extensions to the initial 4 arithmetic operations.

Geometry – Shapes

Mathematically, what came into existence in the very beginning were numbers drawn as diagrams or diagrams represented as numbers. These are triangles, squares, rectangles, circles, ellipses and all other different shapes and diagrams. This brings us to a branch called Geometry. Euclid, the Father of Geometry, believed that Geometry is what was used by God to create nature.

Algebra – Expressions and Equations

The branch of mathematics which deals with the format of representation of variables is what we call as Algebra. It includes various algebraic expressions and equations. Algebra is one of the branches of

https://byjus.com/maths/arithmetic-geometry-and-algebra-in-math/

Dam damage

https://www.creape.org.br/profissionais-que-vistoriam-serro-azul-emitem-nota-de-esclaracimento/

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TECH PRODUCTS by **ROBOTIC@**

1 - https://bioandhealthdrones.wordpress.com/2020/08/25/a-drones-nest/
2 - https://bioandhealthdrones.wordpress.com/2020/08/21/drone-navigation-without-gps-neither-gprs/
3 - https://bioandhealthdrones.wordpress.com/2020/08/13/alexa-for-cancer-patients/
4 - https://bioandhealthdrones.wordpress.com/2017/01/31/a-biotech-platform-for-laboratory-biosecurity/
5 - https://likamicrogravity.wordpress.com/

SPIN-OFFs by **ROBOTIC@**

1- http://healthdrones.tech/
2- https://www.irrd.org/

SOCIAL DEMAND by **ROBOTIC@**

1- https://www.irrd.org/oilspillbr/
2- https://www.irrd.org/respostaemergencial/
3- https://www.irrd.org/geotemporal/
4- https://www.irrd.org/covid-19/graficos-interativos/
5- https://www.irrd.org/covid-19/diagramas-de-risco/
6- https://www.irrd.org/covid-19/
7- https://www.irrd.org/covid-19-mw/

RELEVANCE by Cambridge: "**connected with what is happening or being discussed**"

ROBOTIC@ - Health Drones

https://www.cs.york.ac.uk/circus/RoboCalc/

2019 - Humanitarian Emergency Response for UNICEF

https://www.unicef.org/malawi/press-releases/brazilian-scientists-unicef-use-technology-predict-disease-outbreaks-after-floods

https://www.mwnation.com/new-technology-to-help-detect-disease-outbreak/

https://www.diariodepernambuco.com.br/noticia/vidaurbana/2019/04/pernambucanos-atendem-vitimas-de-ciclone-na-africa.html

https://revistapegn.globo.com/Startups/noticia/2019/04/uma-startup-brasileira-ajuda-prevenir-epidemias-no-malawi.html

2019 - OilSpills Emergency Response for Pernambuco

https://www.diariodepernambuco.com.br/noticia/vidaurbana/2019/11/projeto-da-ufpe-e-ufrpe-coleta-agua-contaminada-por-oleo-sem-contato-d.html

https://www.ufpe.br/agencia/noticias/-/asset_publisher/VQX2pzmP0mP4/content/projeto-desenvolvido-na-ufpe-e-capaz-de-coletar-agua-contaminada-pelo-oleo-de-forma-rapida-e-sem-risco-de-contato-direto-do-coletor/40615

http://www.ufrpe.br/br/content/comit%C3%AA-da-crise-do-%C3%B3leo-do-estado-de-pernambuco-se-re%C3%BAne-na-ufrpe

2020 - COVID-19 Emergency Response for Pernambuco and Brazil

https://revistapesquisa.fapesp.br/drones-no-combate-a-covid-19/

https://www.ucl.ac.uk/news/2020/jul/helping-track-and-reduce-covid-19-infections-northeast-brazil

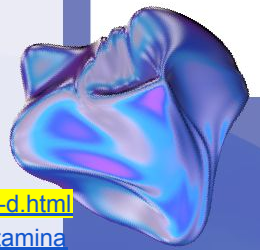
https://www.diariodepernambuco.com.br/noticia/vidaurbana/2020/07/plataforma-criada-em-pe-ganha-destaque-em-publicacao-internacional.html

https://g1.globo.com/jornal-nacional/noticia/2020/04/11/drone-ajuda-no-combate-ao-coronavirus-no-recife.ghtml

https://www.correiobraziliense.com.br/app/noticia/ciencia-e-saude/2020/03/20/interna_ciencia_saude,835616/coronavirus-plataforma-pode-ajudar-a-minimizar-o-contagio.shtml

https://radios.ebc.com.br/tarde-nacional/2020/05/drones-estao-sendo-utilizadas-para-combater-o-covid-19

2020 - Humanitarian Emergency Response on COVID-19 for UNICEF



2020 Publications on Applications

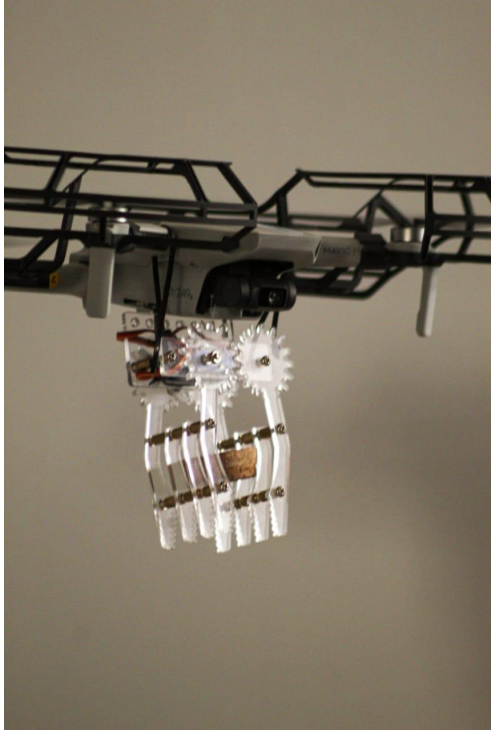
FERRER MIRANDA, EDYNIESKY ; DE ALMEIDA, ERIVÂNIA CAMELO ; CRISTINO, CLAUDIO ; **ALBUQUERQUE, JONES** ; SANTORO, KLEBER REGIS . Timeliness of vesicular disease notification system in Brazilian foot and mouth disease surveillance program. Transboundary and Emerging Diseases, v. 1, p. 1-15, 2020.

ALVES, RAYANNA BARROSO DE OLIVEIRA ; SILVA, HERNANDE PEREIRA DA ; FILHO, JOSÉ COELHO DE ARAÚJO ; DOMINGUES, MARCO ANTONIO DE OLIVEIRA ; **ALBUQUERQUE, JONES OLIVEIRA DE** . Use of Vegetation Cover Index (ICV) to identify susceptible areas to desertification process in the semiarid municipalities of Pernambuco, Brazil. INTERNATIONAL JOURNAL OF ADVANCED ENGINEERING RESEARCH AND SCIENCE, v. 7, p. 53-63, 2020.

BEM, E. S. ; Silva, Hernande P. ; **ALBUQUERQUE, J.** . Spectral Calculation for Carbon Stock Estimation in Fragments of the Brazilian Atlantic Forest: Case Study Carried out in the Environmental Protection Area of Guadalupe on the Southern Coast of the State of Pernambuco - BR. Revista Científica Semana Acadêmica, v. 1, p. 1-29, 2020.

BEM, E.S.; SILVA, H. P. ; ALBUQUERQUE, J. O. ; ALVES, R. B. O. ; RODRIGUES, R. H. A. ; BORGES, M. A. L. ; VASCONCELOS, L. J. F. C. ; RAMOS FILHO, A. S. ; RAMALHO, E. F. R. ; MARQUES, P. C. F. ; LIMA FILHO, J. L. . Sistema de Informações Geográficas e Bioepidemiológicas para Monitoramento da Contaminação por COVID-19 (Sars-CoV-2) na Região Metropolitana do Recife, Pernambuco - BR. In: Luís Paulo Souza e Souza. (Org.). COVID-19 no Brasil: Os Múltiplos Olhares da Ciência para Compreensão e Formas de Enfrentamento. 3ed.Ponta Grossa, PR: Atena, 2020, v. , p. 135-146.

Next steps for Apllications



A1. Extension of the RoboChart notation to allow the specification of swarm robots, involving collections of (possibly heterogeneous) robots;

A2. Extension of the RoboChart notation with probabilistic transitions;

A3. Definition of a simulation language;

A4. Translation from RoboChart (with the above extensions) to a simulation notation;

A5. Translation from the simulation notation to the language of a target platform (possibly C++);

A6. Definition of a controlled natural language (CNL) to model the environment;

A7. Translation from CNL to RoboChart;

A8. Extension of the RoboTool to incorporate the above facilities;

A9. **Development of case studies** (from an initial model, through simulation to a concrete implementation) that illustrate the new features

A10. **Integration with the platform** FIWARE.

DIFFICULTIES

- Graduate programs rules
- No human capital for science
- Use just of 53.79% of the TOTAL Initial Budget
- ...

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