08.04.2025 (1)
ART Seminar
A. Ram

Finding an MSc Supervisor (Robyn Araujo).

(1) Getting acquainted
  (a) Wander the Halls
  (b) Lunch
  (c) Google - Uni Melb page - publicst
  (d) Papers in Nature Communications
  (e) Download 2023 and 2018 and SI
  (f) Brief look - ... George Mason ... and REFERENCES

2023 PICTURES! EXAMPLES!

Refs. 3 2018 paper of Araujo and Liotta

Refs 20, 29 and 30 are books

20. Cox, Applications of polynomial systems Amer. Math. Soc 2020

29. Feinberg, Foundations of Chemical Reaction Network Theory, Springer 2019

30. Cox, Little, O'Shea, Ideals, Varieties and Algorithms, Springer 2015.

08.04.2015 (2)
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Keywords from references:

Robustness, Robust Perfect Adaptation

Design principles.

2018 PICTURES! EXAMPLES!

Refs. 24, 25, 26 are Araujo and Liotta

Ref 24. A control theoretic paradigm for cell signaling networks, Nat. Rev. Drug Discov. (2007)

Ref 25, Proteins, drug targets and the mechanisms they control, Curr. Opin. Chem. Biol. (2006)

Ref 26. A mathematical model of combination therapy using the EGFR signalling network, Biosystems (2007)

Ref 1 is a BOOK.

Wagner, Robustness and Evolvability in Living Systems, 2005 Princeton Univ. Press.

Looking at the 2023 paper

From Results: polynomial invariants

"(see Theorem 1 SI Section 5.1.5)

If S is an RPA capable CRN with

interacting molecules $x_1, \ldots, x_n$

mass action rate equations $f_1, \ldots, f_n$

and if

x_i is an RPA capable variable of S

x_j is a variable that does not exhibit RPA

then there exist polynomials

$h_1, \ldots, h_n \in \mathbb{R}[x_1, \ldots, x_n]$ such that

$h_1 f_1 + \cdots + h_n f_n = q(x_i, x_j)(x_i - c) = p$

where p is the RPA polynomial of S

q is the pairing function for x_i and x_j.

c is the system set point.

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From Methods:

Theorem 1 is proved in SI §S1

The analysis in S2, S3, S4 highlights that the deficiency of 8 fundamentally controls the formation of polynomial invariants obtainable through linear coordinate changes.

2018 paper

From Results

- ...terms of the RPA equation's determinant expansion as a set R.

- Supplementary Note 2: Each member of R represents a unique product of three fundamental mathematical elements of signal transmission [1] ... [2] ... [3] ....

From Methods:

"We show in Supplementary Note 2 that.

08.04.2025 (5)
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RPA occurs only when

$\det(M_{IO}) = 0$ and $\det(J_n) = 0$

where

$J_n = \frac{\partial(f_1, \ldots, f_n)}{\partial(P_1, \ldots, P_n)}$ is the $n \times n$ Jacobian

for $f = \begin{pmatrix} f_1 \\ \vdots \\ f_n \end{pmatrix}$ and M_{IO} is the $(n-1) \times (n-1)$ input-output minor of J_n.

- Supp. Notes 1 and 2 provide definitions..."
- Supp. Note 3 provides full details on our topological approach to the solution of the RPA problem
- The constraints on the reaction kinetics that are imposed by the creation of S-sets and M-sets from the RPA are presented... in Supp. Note 4.