

Life is a matter of priorities

by Stefano Chiaverini,
DIEI, Università di Cassino
Roma – 9 gennaio 2018 – ADL Festschrift

Life is a matter of priorities

To Alessandro De Luca,
dearest friend,
the deepest and most elegant
not only in research

by Stefano Chiaverini,
DIEI, Università di Cassino
Roma – 9 gennaio 2018 – ADL Festschrift

Life is a matter of priorities

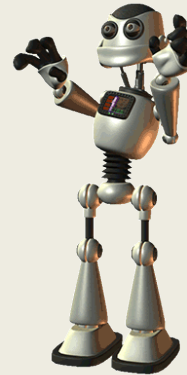
To Alessandro De Luca,
dearest friend,
the deepest and most elegant
not only in research

by Stefano Chiaverini,
DIEI, Università di Cassino
Roma – 9 gennaio 2018 – ADL Festschrift



Priorities

- Priorities come into play when choices can be made
- A good choice will achieve higher priority goals by sacrificing as few lower priority ones as possible



Redundancy

- The more choices are available, the more redundancy exists in a system
- Thus, a redundant system may allow to better satisfy multiple goals



All roads lead to Rome...

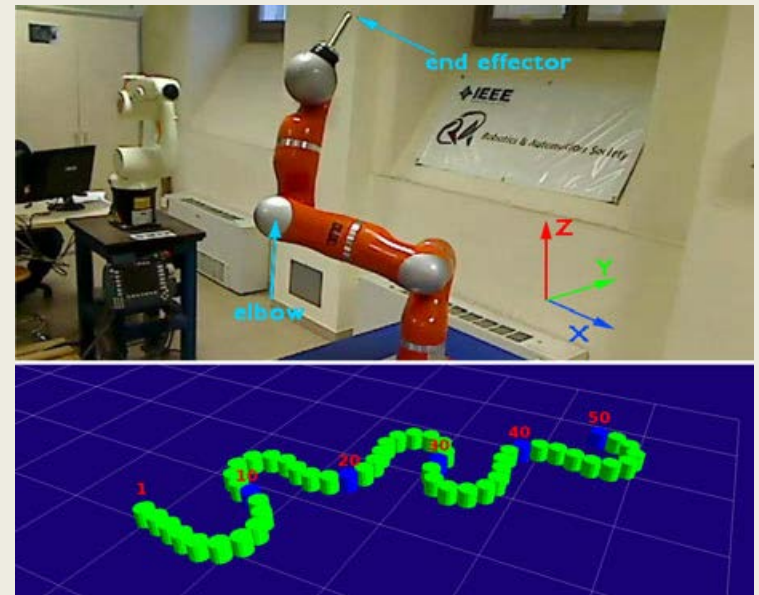
Redundancy

- Of course, the existence of multiple possibilities does not solve a problem by itself
- That's why everybody needing to take a choice looks for proper advice...



Redundancy in ADL Robotics

- Not surprisingly wrt the relevance of the issue, Alessandro has devoted much effort to redundancy resolution methods:
 - about 20% of his journal papers
 - about 15% of his conference papers
 - mostly written in the 90's and in the 10's

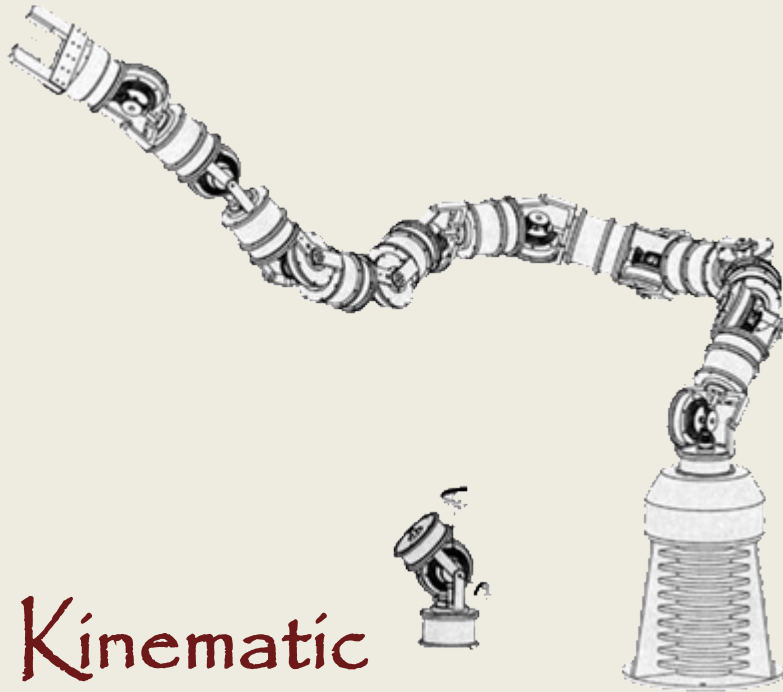


Redundancy in ADL Robotics

- Redundancy resolution has been applied, in brief, to:
 - optimization of various criteria
 - steering underactuated chains by ee commands
 - image-based visual servoing
 - gaze control of a humanoid robot head
 - handling of hard joint limits

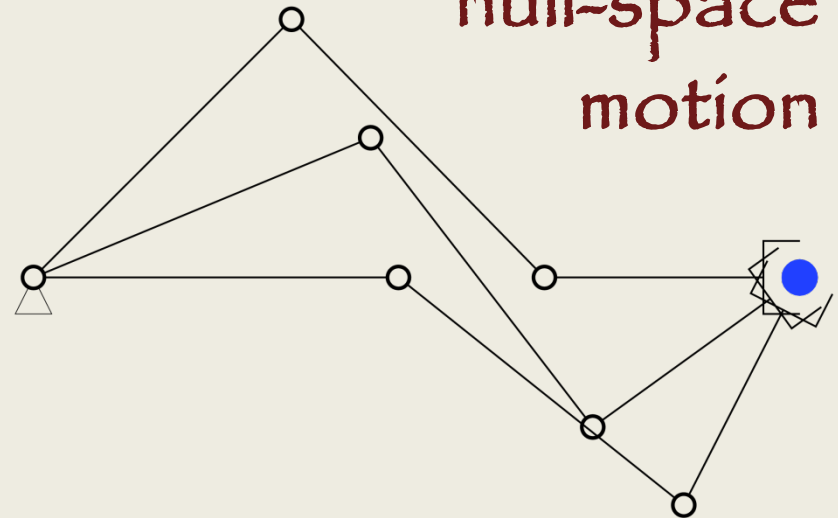
Redundancy and task priority

- Redundancy depends on the task



- Kinematic redundancy

- Task priority: an example of primary task and null-space motion



Multiple priorities

- Consider l tasks, from highest to lowest priority (indexed by k)

$$\dot{x}_1 = J_1 \dot{q} \quad \dots \quad \dot{x}_k = J_k \dot{q} \quad \dots \quad \dot{x}_l = J_l \dot{q}$$

- Define the Augmented Jacobian of the first k tasks

$$J_{A,k} = (J_1^T \quad J_2^T \quad \dots \quad J_k^T)^T$$

- Compute the null-space projector for $J_{A,k}$

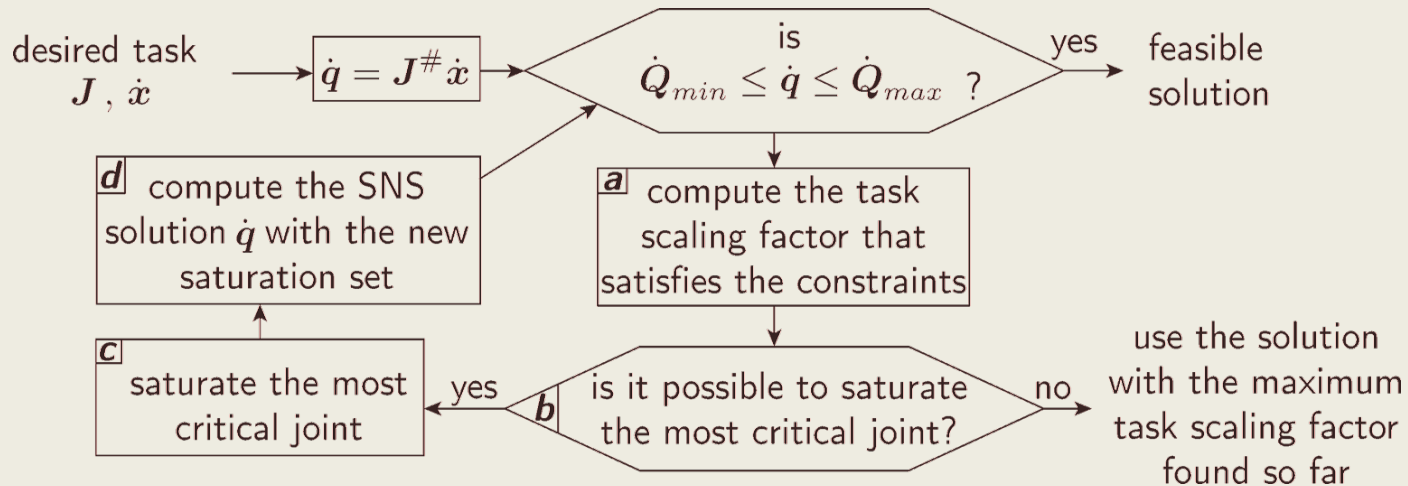
$$P_{A,k} = P_{A,k-1} - (J_k P_{A,k-1})^\# J_k P_{A,k-1} \quad \text{with} \quad P_{A,0} = I$$

- Compute the joint velocity fulfilling the k highest-priority tasks

$$\dot{q}_k = \dot{q}_{k-1} + (J_k P_{A,k-1})^\# (\dot{x}_k - J_k \dot{q}_{k-1}) \quad \text{with} \quad \dot{q}_0 = 0$$






Saturation in the Null Space

- The joint bounds (range, velocity, acceleration) are locally shaped as hard joint velocity constraints
- Basic algorithm (single task):



Saturation in the Null Space

- In the case of multiple prioritized tasks, higher priority tasks are preserved (up to a scaling, if needed) by using all the available robot capabilities they need, while lower priority tasks are accommodated (and scaled, if needed) with the residual robot capabilities

Tasks	
Name	Priority
<input type="checkbox"/> Make monthly report	 Highest (900)
<input type="checkbox"/> Read and sign contract	 High (700)
<input type="checkbox"/> Prepare presentation	 Normal (500)
<input type="checkbox"/> Create weekly plan	 Low (300)
<input type="checkbox"/> Empty email box	 Lowest (100)

Look into this...



F. Flacco, A. De Luca, O. Khatib,
“Control of redundant robots under hard joint
constraints: Saturation in the null space,”
IEEE Transactions on Robotics,
vol. 31, no. 3, pp. 637-654, 2015.

Young Author Best Paper Award 2016
by the IEEE RAS Italian Chapter

To conclude...



To conclude...



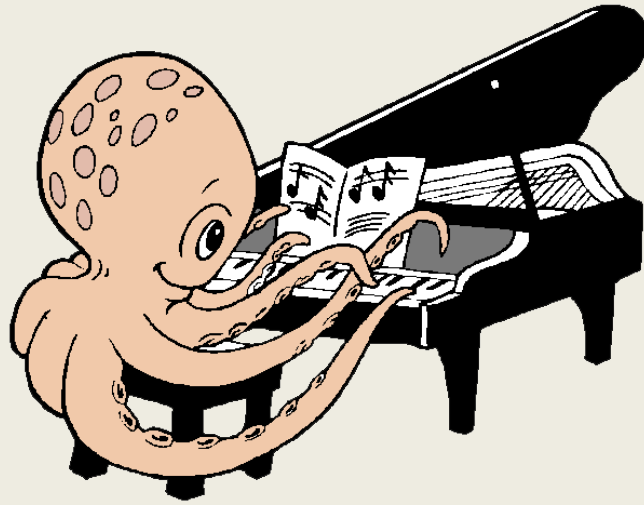
- A suggestion
- A memory
- A_uguri!!!

How to improve your musical redundancy

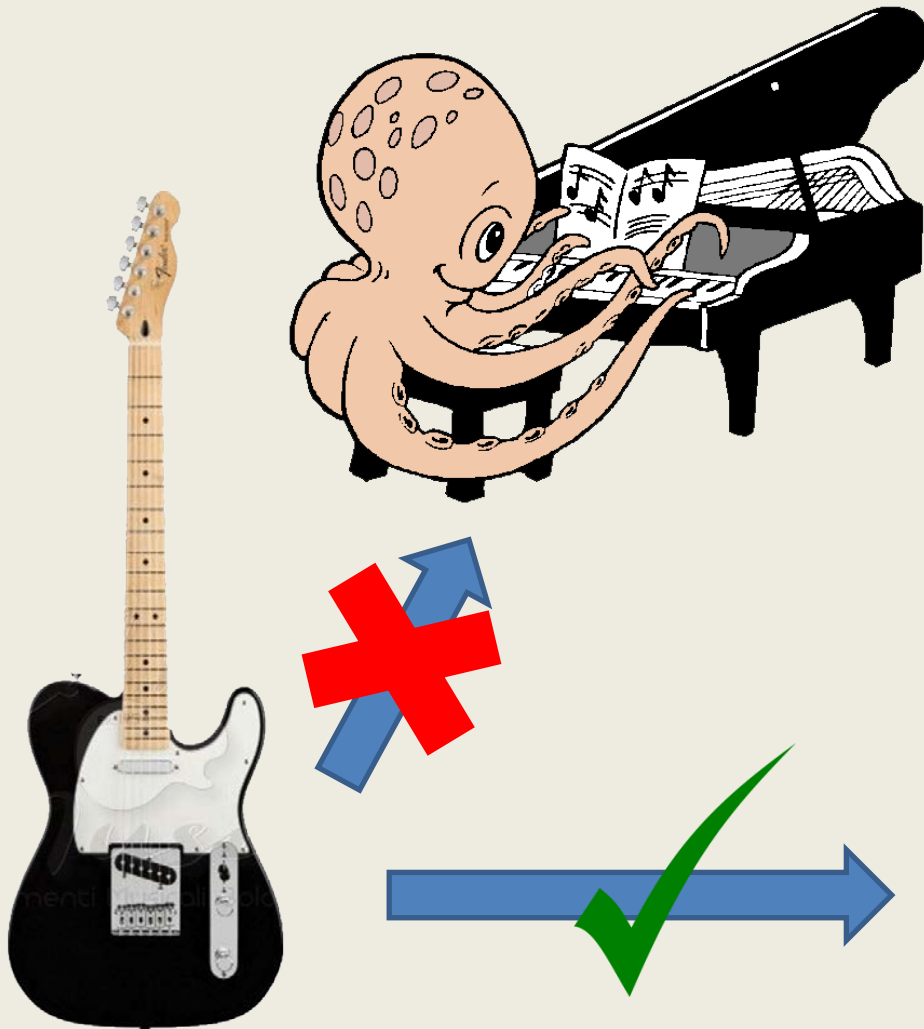


<https://www.youtube.com/watch?v=hRv8VLzzERs>

How to improve your musical redundancy



How to improve your musical redundancy



S. Maria del Fiore (Mascioni, opus 805)

2001 IEEE Int. Conf. Robotics & Automation
Seoul, 23/5/2001



Lorenzo Sciavicco Symposium

Verucchio, 18/7/2009



Auguri Alessandro!!!

