Biologically inspired control inspired by muscle synergies

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MARIE CURIE ACTIONS

RobotDoC
Robotics for Development of Cognition

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RobotDoC Entrepreneurship Workshop
IIT, 22/03/2012
Genoa, Italy

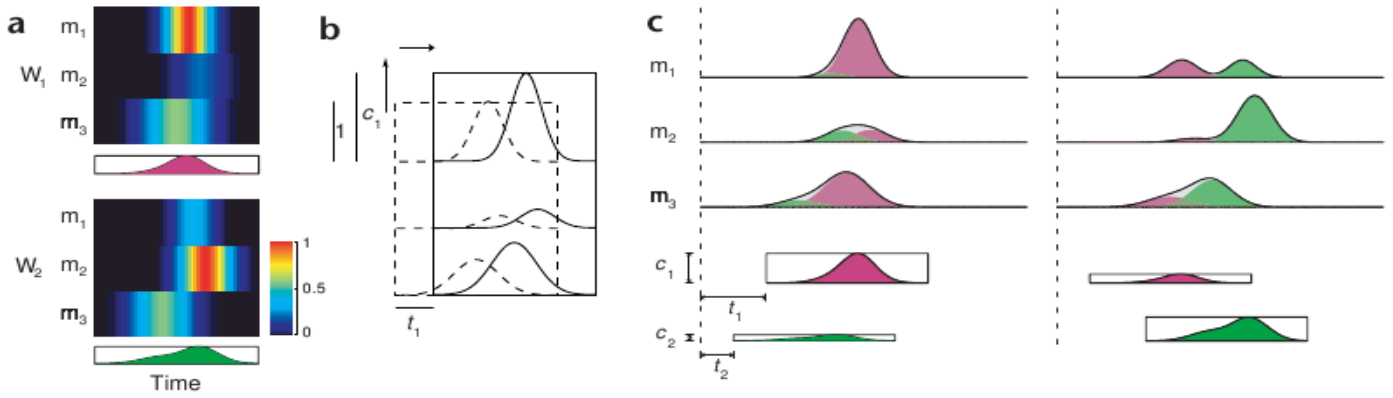
Research

Muscle synergies

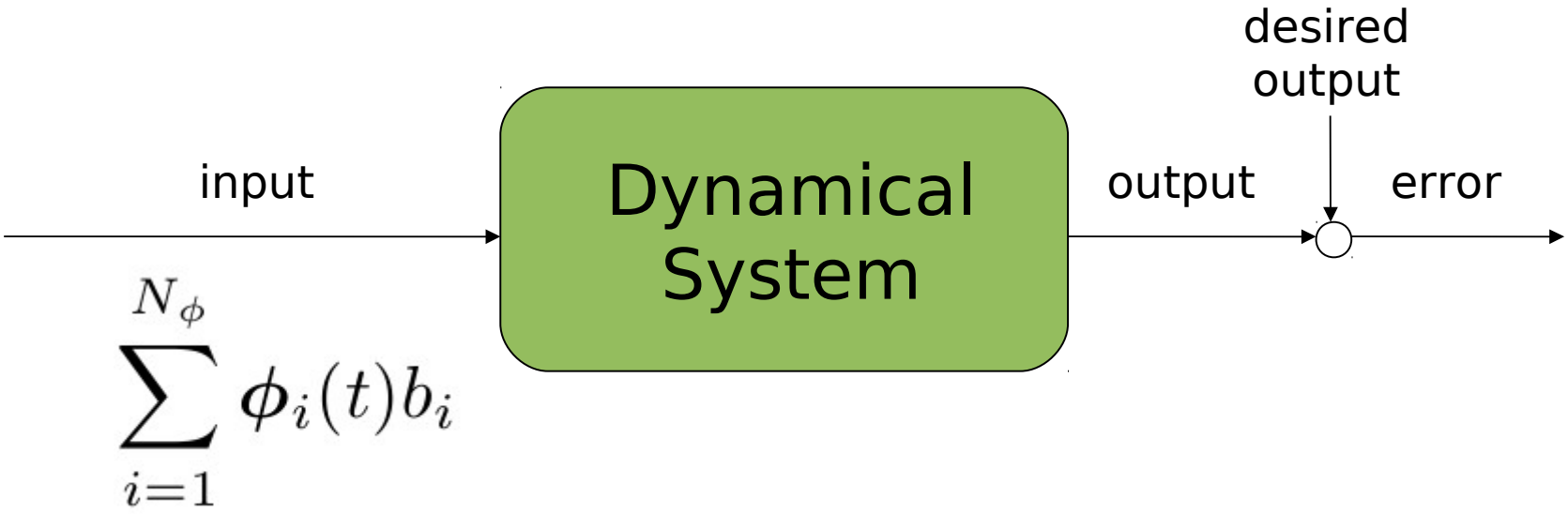
The inspiration

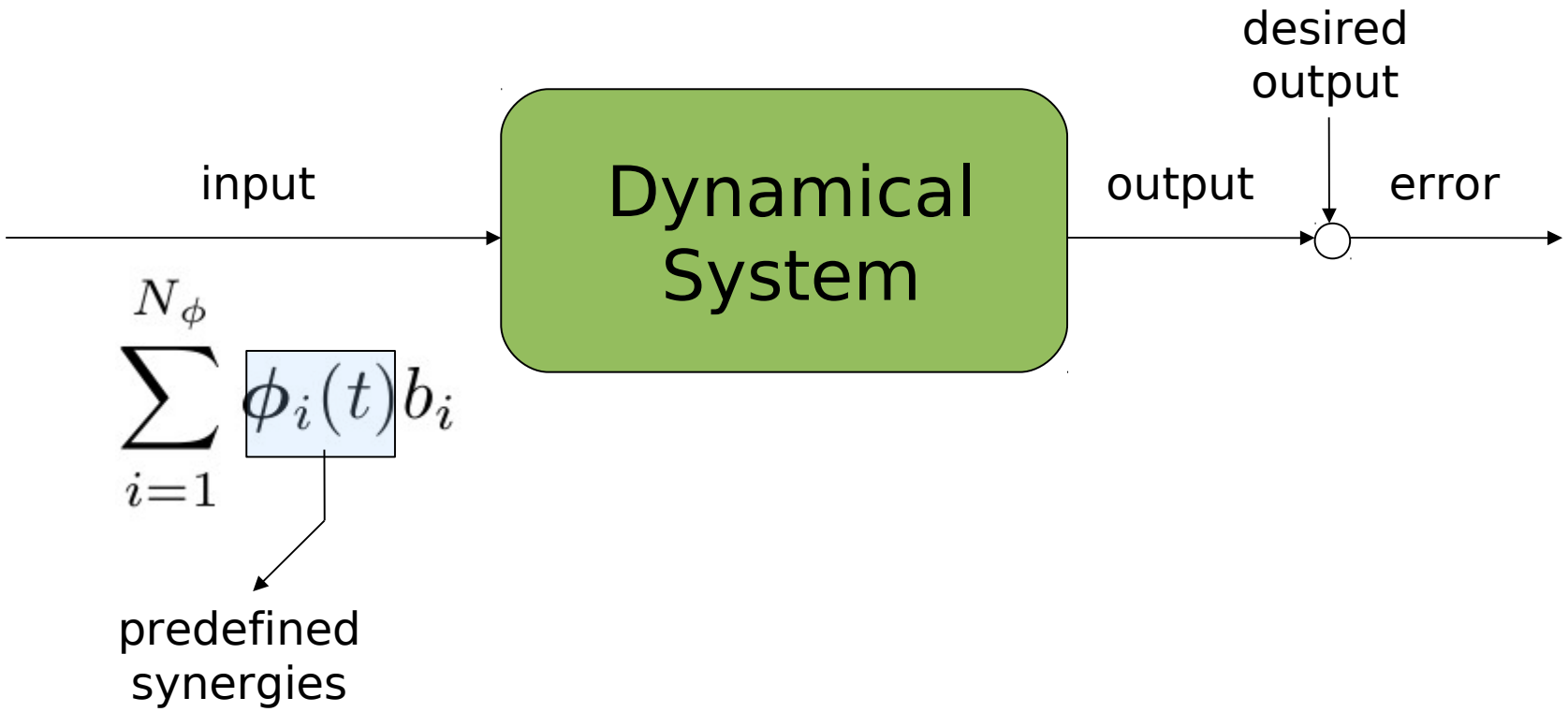
complex movements are generated as <u>combinations of primitives</u> stored in the central nervous system (muscle synergies)

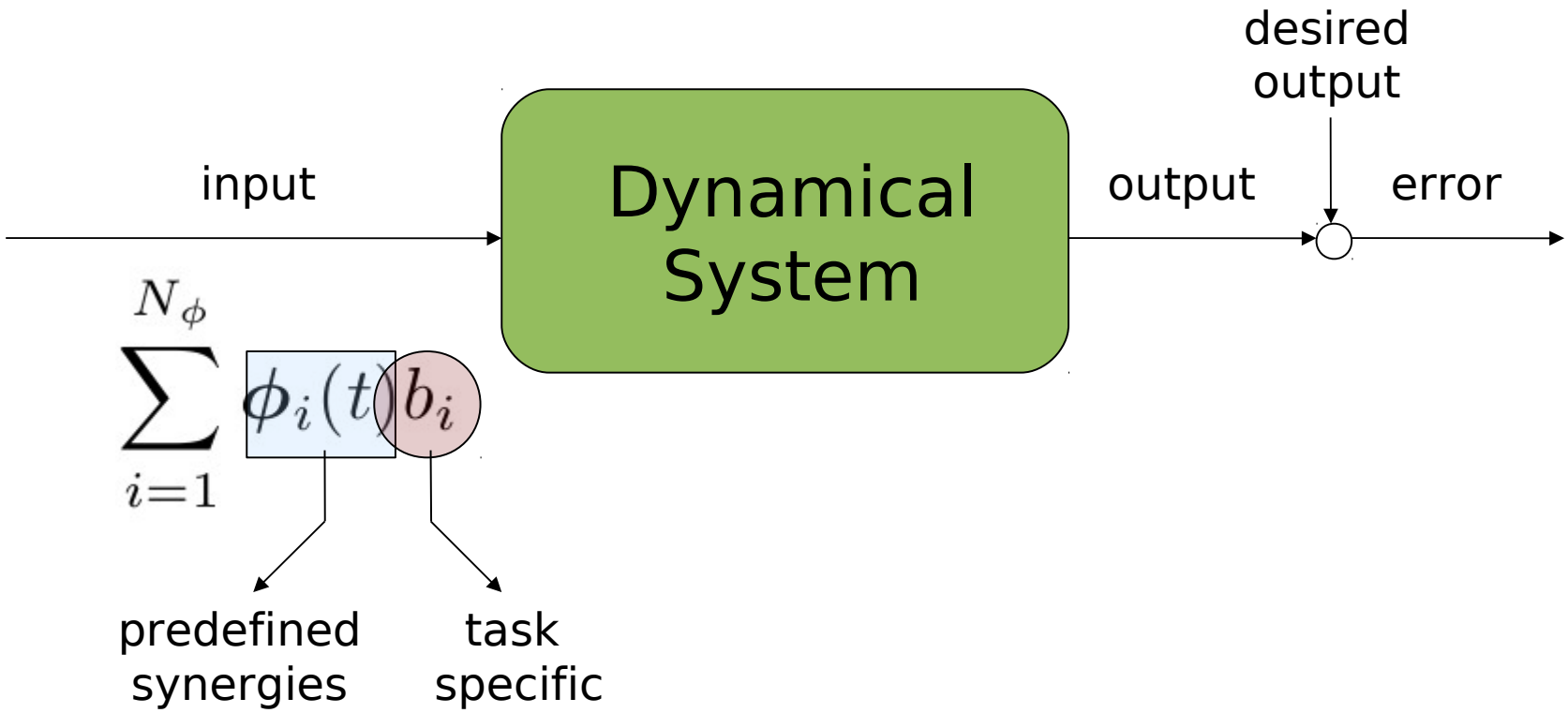
$$\mathbf{m}(t) = \sum_{i=0}^{N} c_i \mathbf{w}_i (t - t_i)$$



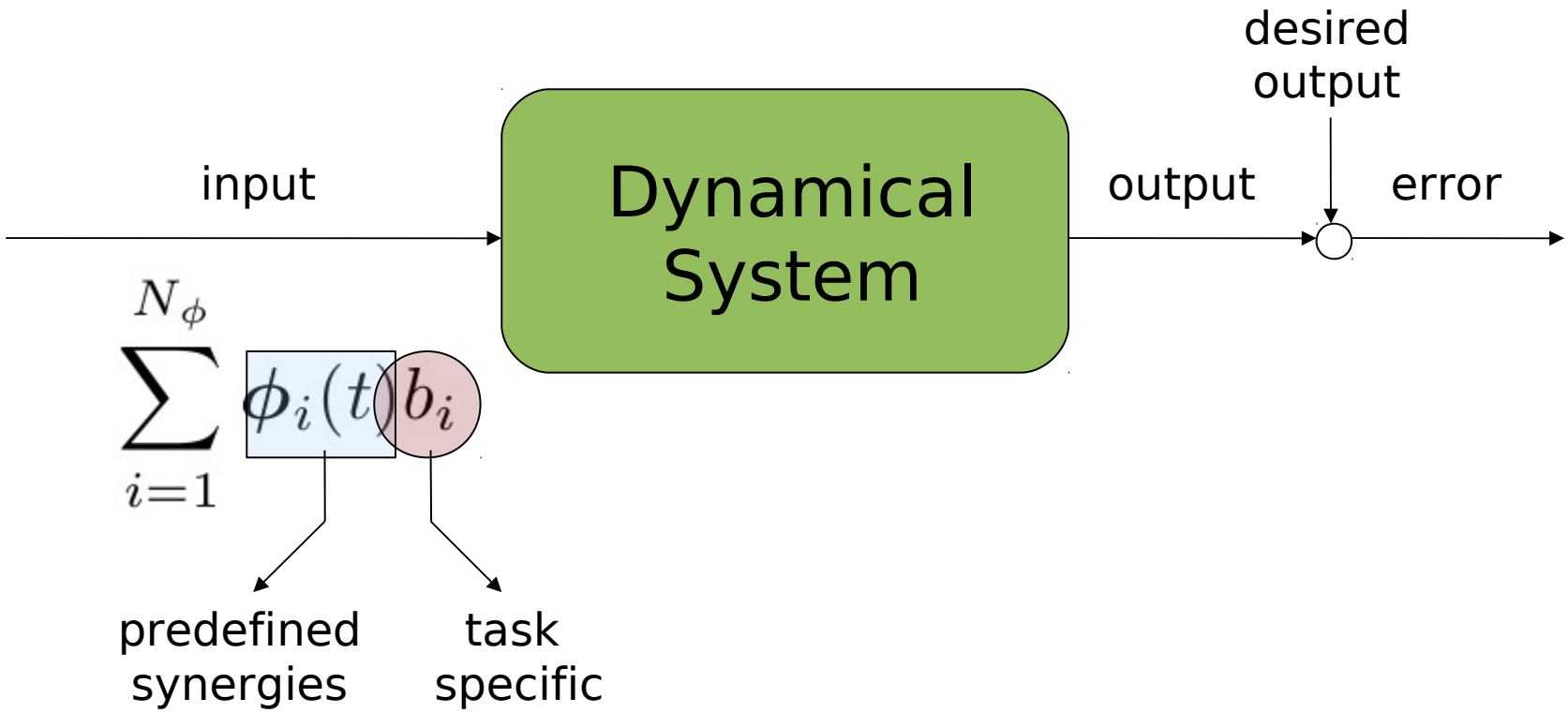
d'Avella A, Saltiel P, Bizzi E. *Combinations of muscle synergies in the construction of a natural motor behavior.* Nature neuroscience. 2003;6(3):300-8.


desired
output
input
Dynamical
System
output
error
$\sum_{i=1}^{N_\phi} \phi_i(t) b_i$


desired
output
input
Dynamical
System
output
error
$\sum_{i=1}^{N_\phi} \phi_i(t) b_i$
predefined
synergies


desired
output
input
Dynamical
System
output
error
N_ϕ
$\sum_{i=1}$
$\phi_i(t)b_i$
predefined
synergies
task
specific

Research directions: identification of synergies, feedback, dependence on the system, modelling ...



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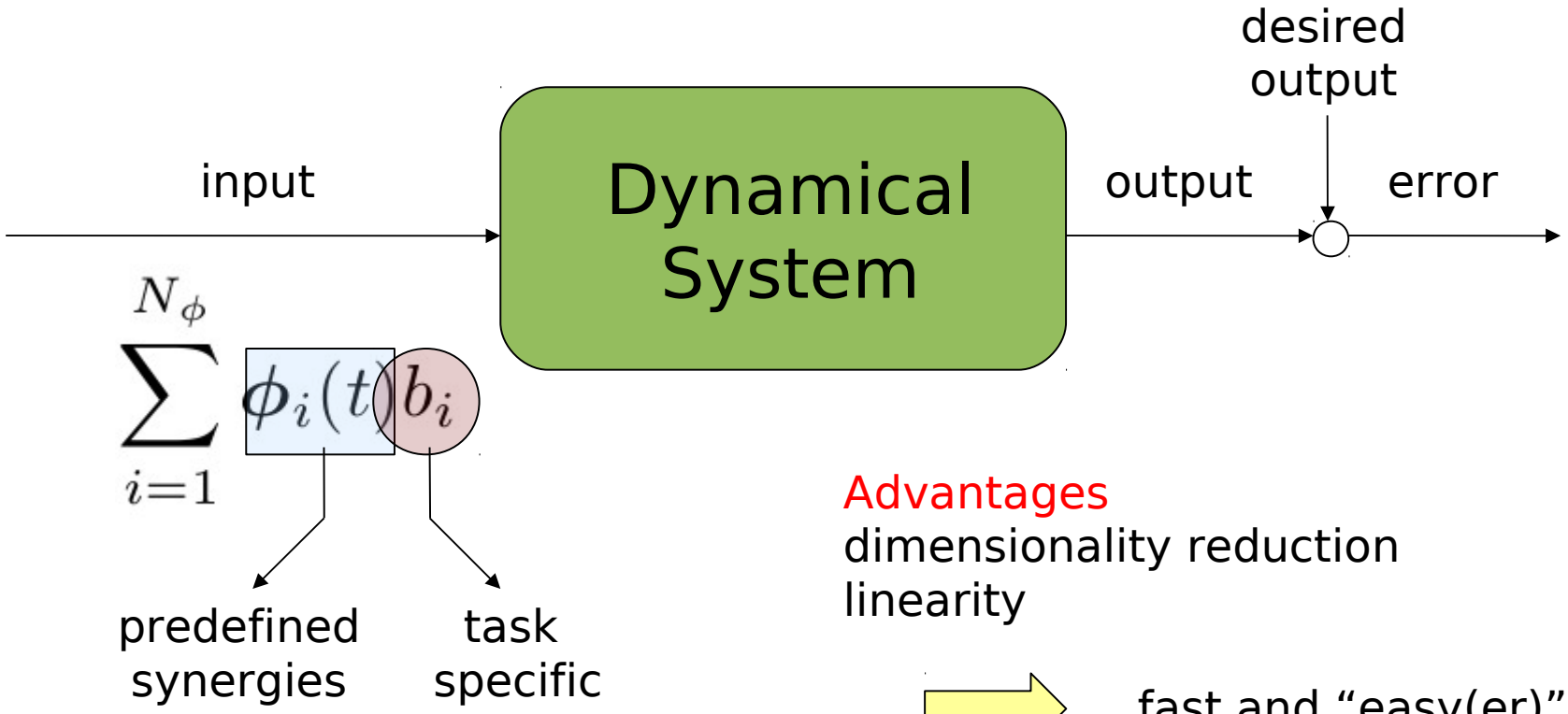


Advantages

dimensionality reduction

linearity

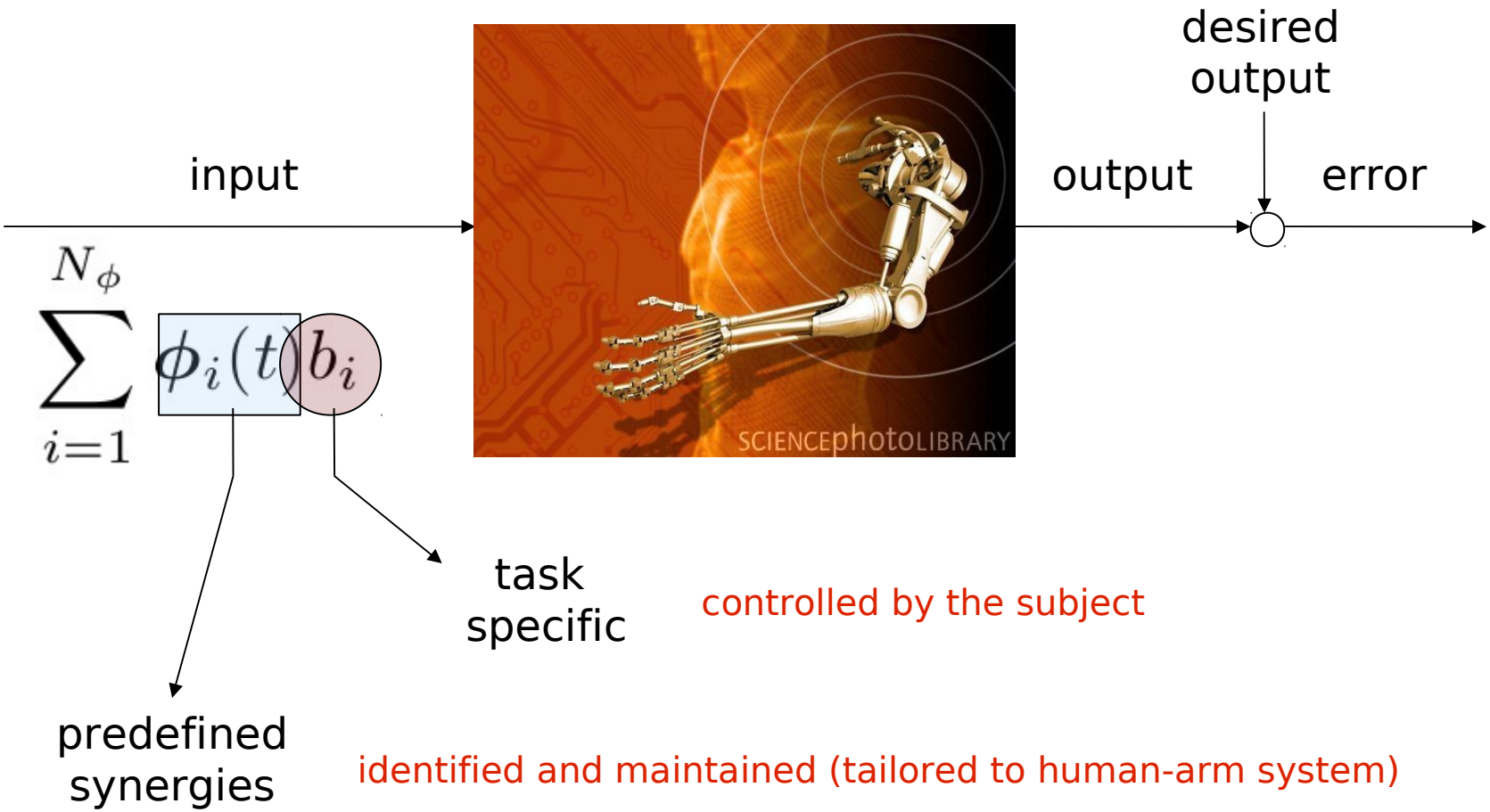
⇒ fast and “easy(er)”

biologically inspired

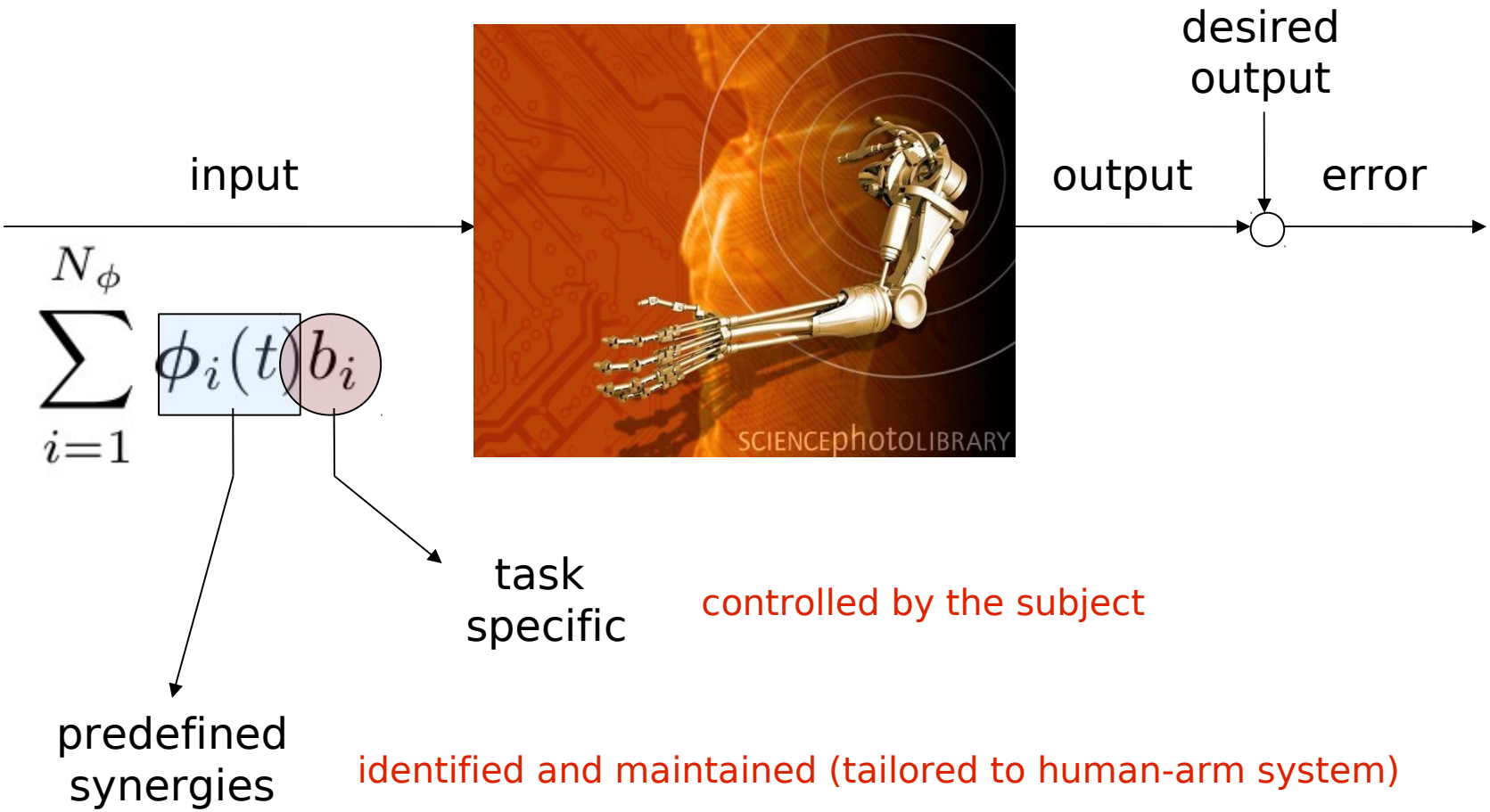
⇒ modelling

Applications

Robotic prosthesis

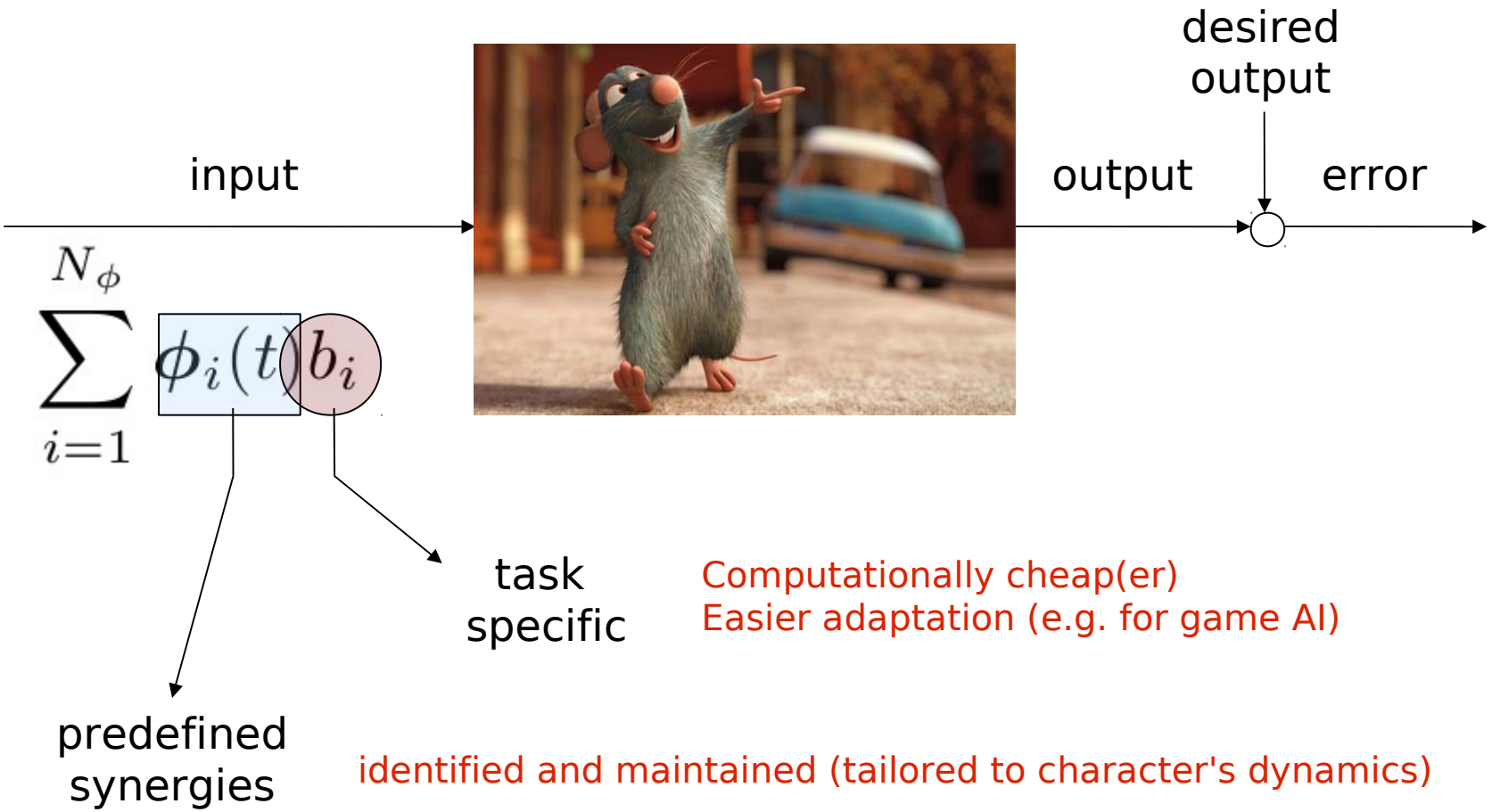


Robotic prosthesis



Does a biologically inspired controller contribute the acceptance of the robotic prosthesis?

Characters animation



Computationally cheap(er)
Easier adaptation (e.g. for game AI)

identified and maintained (tailored to character's dynamics)

Characters animation

desired output

input

output

error

$$\sum_{i=1}^{N_\phi} \phi_i(t) b_i$$

task specific

predefined synergies

Computationally cheap(er)
Easier adaptation (e.g. for game AI)

identified and maintained (tailored to character's dynamics)

Does a biologically inspired controller produce more natural motions?

Thanks!!!