



## PMR 2499 **Requisitos**

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# Comentários iniciais

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- ▶ Importância da documentação do projeto
- ▶ Importância do gerenciamento do projeto
  - ▶ Ferramentas de gerenciamento
  - ▶ **Reuniões periódicas como o orientador**
- ▶ Citar as fontes:
  - ▶ Não citar=Plágio=Responsabilidade ética e penada por lei





# Objetivos

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- ▶ Definir requisitos de projeto
- ▶ Exemplo de metodologia formal:
  - ▶ Rafael Sanchez Souza; Filippo Sanfilippo; José Reinaldo Silva; Arturo Forner Cordero (2016). Modular exoskeleton design: Requirement engineering with KAOS. 6th IEEE International Conference on Biomedical Robotics and Biomechatronics (BioRob): 978 - 983
- ▶ Variáveis de projeto
- ▶ Validação do projeto: Foram atingidos os requisitos?





# Requisitos funcionais

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- ▶ Definição dos requisitos funcionais que o dispositivo/programa tem que desempenhar realizar para cumprir os objetivos.
- ▶ Dar exemplos de requisitos funcionais de um dispositivo funcional (por exemplo, algo que esteja vestindo).
  - ▶ Por exemplo, realizar chamadas telefônicas
  - ▶ Por exemplo, medir e controlar o movimento.





# Requisitos não funcionais

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- ▶ Requisitos não funcionais, sem focar diretamente na função fundamental do sistema, estão relacionados com a experiência do usuário, como por exemplo, comfort, usabilidade ou estética.
- ▶ Exemplos de requisitos não funcionais.



# GOAL ORIENTED REQUIREMENT ENGINEERING WITH KAOS

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- ▶ A goal is an objective the system/software/platform under consideration should achieve.
  
- ▶ Goals support further decisions.
  
- ▶ A well-defined goal provide precise criteria to:
  - ▶ propose a complete a requirement specification;
  - ▶ develop a rationale for requirements;
  - ▶ structure complex requirements documents.





# KAOS (Knowledge Acquisition in Automated Specification)

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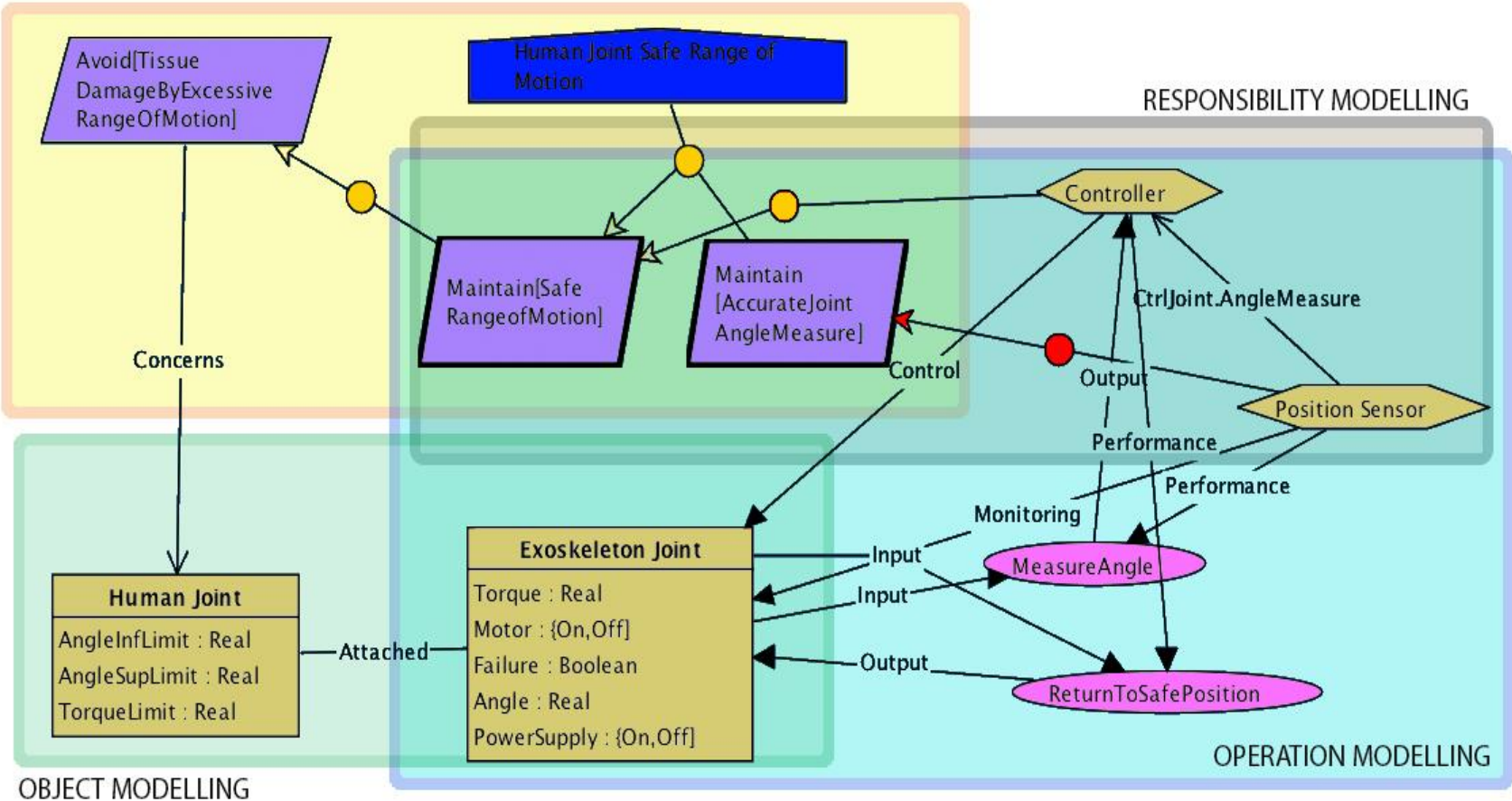
- ▶ Graphic representation of the GORE (Souza et al, 2016)
  - ▶ Goals Diagram.
    - ▶ It is the fundamental model for KAOS in which the project goals are presented. Goals are linked to subgoals through refinements. Avoid[TissueDamageByExcessiveRangeOfMotion] may be refined to the Requirement Maintain[SafeRangeOfMotion] which is constrained by the Domain Property “Human Joint Safe Range of Motion” and again refined into the Requirement Maintain[AccurateJointAngleMeasure].
  - ▶ Object Model.
    - ▶ It allows for the identification of objects, such as entity, relationship, event or agent. Defines the concepts of the application domain, the system constraints and establishes the object characteristics as attributes. The Exoskeleton Joint and the Human Joint relation are defined as “Attached”.
  - ▶ Agent Responsibility Model.
    - ▶ It defines the responsibilities between agents and requirements. The Controller and the Position Sensor are responsible for maintaining a safe range of motion and an accurate joint angle measurement.
  - ▶ Operation Model.
    - ▶ It shows how the objects work together to achieve the system requirements by defining the state transitions. If angles are off limits, the Controller will bring the Exoskeleton Joint back to a safe position.





# KAOS

## GOALS MODELLING







# Exoskeleton design (Souza et al, 2016)

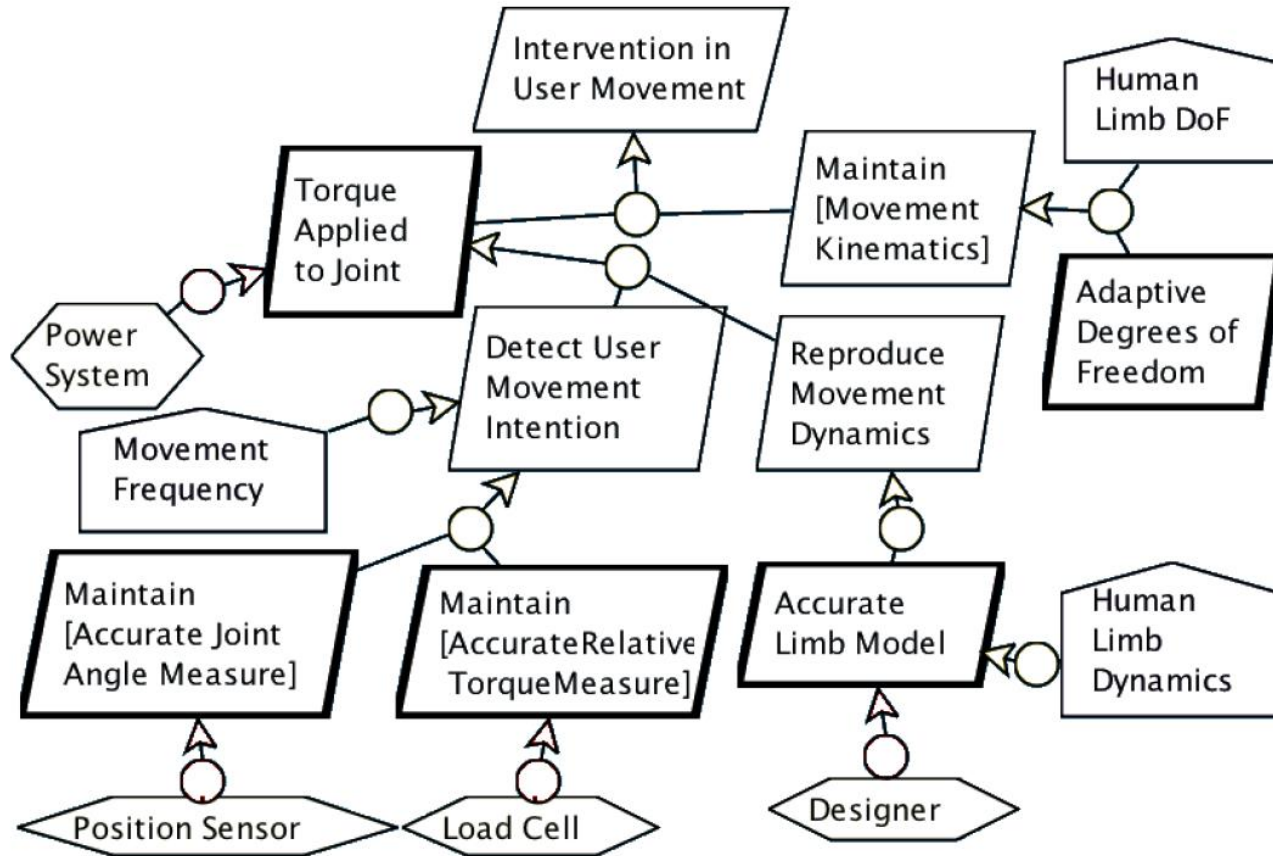
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- ▶ Four primary goals were defined for this work:
  - ▶ Modularity;
  - ▶ Commercial Feasibility;
  - ▶ Maintain User Safety;
  - ▶ Intervention in User Movement



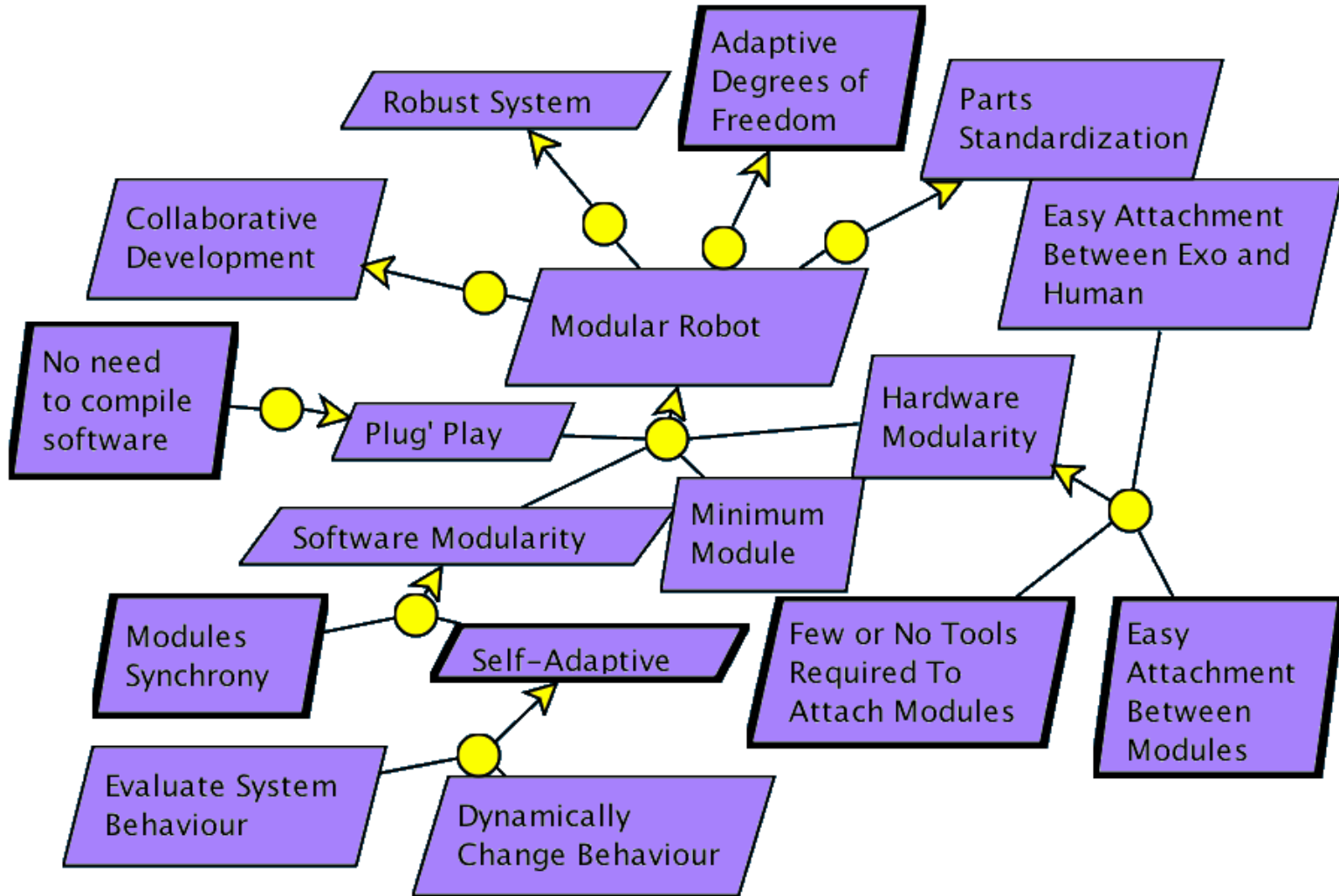


# Intervention



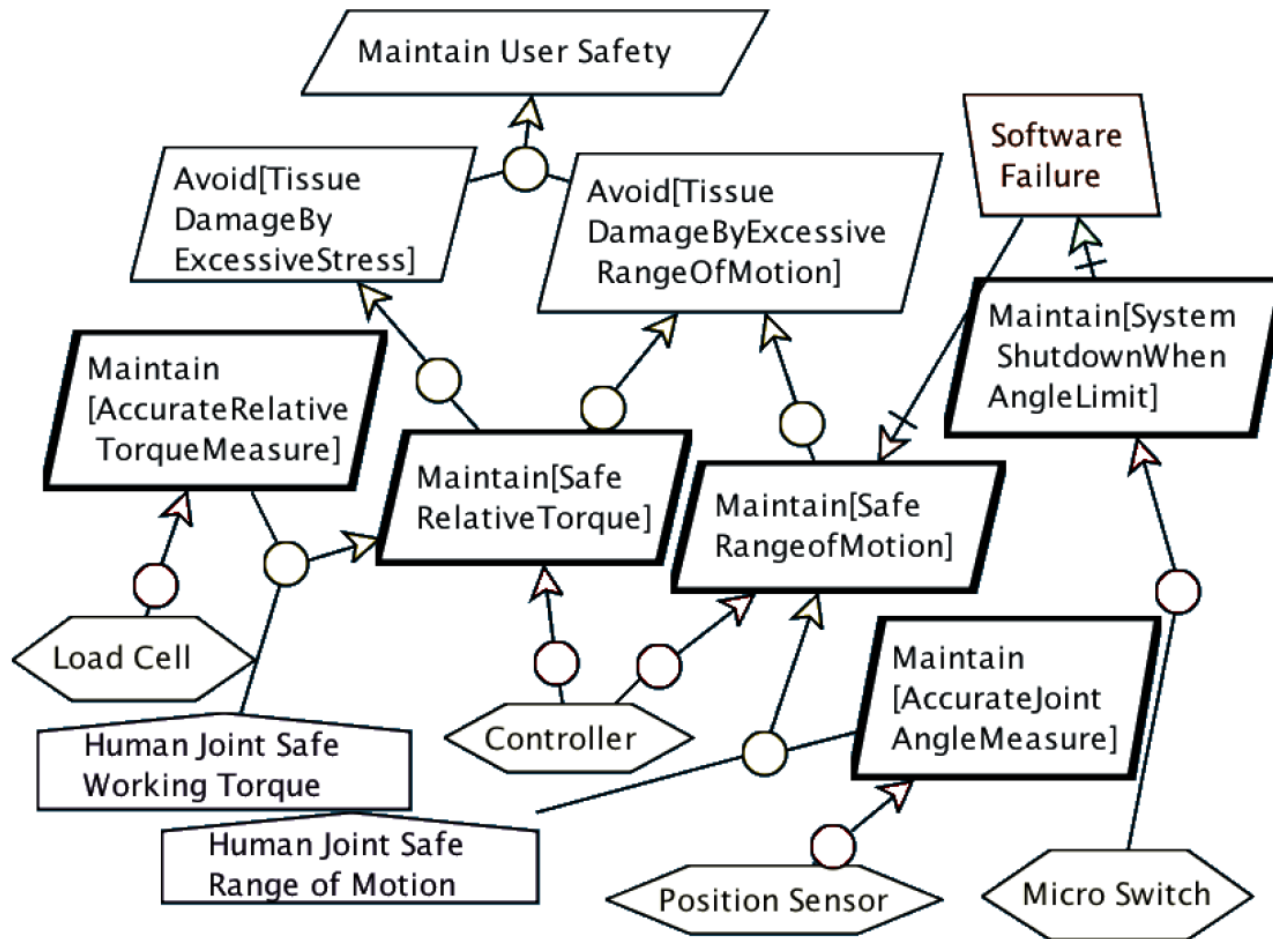


# Modularity





# User safety





# Formal definition

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## **Goal** Maintain[SafeRelativeTorque]

**Definition** The Exoskeleton Joint torque should stay below the maximum torque the human joint can handle.

### **FormalDef**

$$\forall ej : ExoJoint, hj : HumanJoint \text{ Attached}(ej, hj) \Rightarrow \quad (1) \\ ej.Torque \leq hj.SafeTorque.$$

## **Goal** Maintain[SafeRangeOfMotion]

**Definition** The Exoskeleton Joint angle should stay between the maximum and minimum angles the human joint can handle.

### **FormalDef**

$$\forall ej : ExoJoint, hj : HumanJoint \text{ Attached}(ej, hj) \Rightarrow \quad (2) \\ hj.AngleInfLimit \leq ej.Angle \leq hj.AngleSupLimit.$$

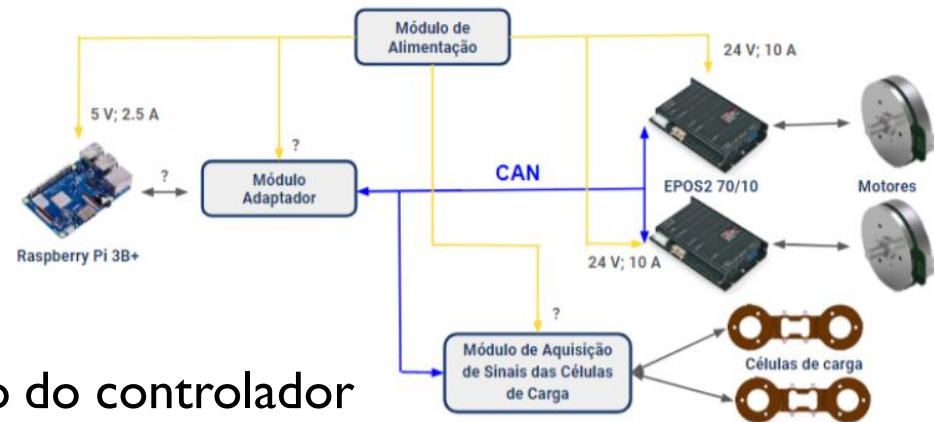


# Exemplo

## ▶ Instrumentação e controle de exoesqueleto

### ▶ Medir de torque e ângulos:

- ▶ Faixas, precisão e acurácia
- ▶ Frequências de amostragem



### ▶ Controles

- ▶ Frequência de atualização do controlador

### ▶ Alimentação dos motores:

- ▶ Tensão de alimentação e corrente máxima



# Passos. Steps

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