

DAME – Digital assessment in the context of modular education

Proposal for the Education Innovation Funds

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GOAL

Develop a formative and summative assessment framework and the corresponding digital tools to make modular on-demand education feasible and implement in the context of the course 4DB00 Dynamics and Control of Mechanical Systems

MOTIVATION

The success of the project CMODE Constructing knowledge with Modular On-demand Digital Education, depends for a significant part on a good design of the formative and summative assessment strategy and the availability of the needed digital assessment tools.

In the educational innovation project eFABLES – Smart digital formative assessment in the context of blended learning, we have developed a digital (formative) assessment tool that makes it possible to formulate open questions for problems involving relatively complex mathematical calculations and provide students with tailored corrections to their answers. The screenshot in the appendix gives a glimpse of how the tool works. Currently we are running a pilot in the course 4DB00 Dynamics and Control of Mechanical systems and we expect to have the reporting ready in February 2019.

The experience with eFABLES has made me realize that the resources we have in CMODE are not sufficient to develop the assessment framework and digital tools we need. Hence this request for funding to make a thorough design of the assessment framework in de context of modular education.

APPENDIX: Screenshots eFABLES tool

Student view in Canvas

- Home
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This assignment is a pilot to test the implementation of digital learning and assesment for the Dynamics part of this course. In this assignment, you will solve a complete physical problem, using most of the material treated in the course. You can start this quiz or work further on it at any time, which means that you can already solve the first questions after the first lecture.

We appreciate feedback from you about this pilot quiz, to improve this course in the future! You can do so here: [Pilot quiz](#)

NB: We strongly advise you to read the pilot information before starting the quiz, to get acquainted with notation etc: [Pilot quiz Information.pdf](#)

IMPORTANT REQUEST: Please click on Finalize Attempt and then on Submit Attempt after you finish the assignment.

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$$\text{matrix}([L_1 \cdot \cos(\theta(t)) \cdot \frac{d\theta(t)}{dt}, 0, [-L_1 \cdot \sin(\theta(t)) \cdot \frac{d\theta(t)}{dt}]]$$

Your last answer was interpreted as follows:

$$\begin{bmatrix} L_1 \cdot \cos(\theta(t)) \cdot \left(\frac{d\theta(t)}{dt}\right) \\ 0 \\ (-L_1) \cdot \sin(\theta(t)) \cdot \left(\frac{d\theta(t)}{dt}\right) \end{bmatrix}$$

✔ Correct answer, well done.
The entries underlined in red below are those that are incorrect.

$$\begin{bmatrix} \underline{L_1 \cdot \cos(\theta(t)) \cdot \left(\frac{d\theta(t)}{dt}\right)} \\ 0 \\ \underline{-L_1 \cdot \sin(\theta(t)) \cdot \left(\frac{d\theta(t)}{dt}\right)} \end{bmatrix}$$

NOTE: Your answer is incorrect. However, you have correctly differentiated your position vector.

View of a subset of the questions and answers in MOODLE

Using your obtained potential energy, derive the expression for $(V_g)_g^T$:

$$\text{matrix}([k_1 + k_2 + g \cdot (m \cdot L_2 - M \cdot L_1) \cdot \cos(\theta(t)), -k_2], [-k_2, k_2 + m \cdot g \cdot l \cdot \cos(\varphi(t))])$$

Your last answer was interpreted as follows: $\begin{bmatrix} k_1 + k_2 + g \cdot (m \cdot L_2 - M \cdot L_1) \cdot \cos(\theta(t)) & -k_2 \\ -k_2 & k_2 + m \cdot g \cdot l \cdot \cos(\varphi(t)) \end{bmatrix}$

An equilibrium point of this system is $\underline{g}_0 = [0 \ 0]^T$. (Verify this yourself!) Give the condition for k_1 , such that this equilibrium point is stable:

$$k_1 > g \cdot (m \cdot L_2 - M \cdot L_1)$$

Your last answer was interpreted as follows: $k_1 > g \cdot (m \cdot L_2 - M \cdot L_1)$

Determine the total rotational energy $T_{G,rot}$ of the gondola:

$$1/2 \cdot 1/12 \cdot m \cdot (a^2 + b^2) \cdot \left(\frac{d\theta(t)}{dt}\right)^2 + \text{diff}(\varphi(t), t)^2$$

Your last answer was interpreted as follows: $\frac{1}{12} \cdot m \cdot (a^2 + b^2) \cdot \left(\frac{d\theta(t)}{dt}\right)^2 + \left(\frac{d\varphi(t)}{dt}\right)^2$

Give the expression for the total kinetic energy T of the system:

$$1/2 \cdot (M \cdot L_1^2 + m \cdot L_2^2) \cdot \left(\frac{d\theta(t)}{dt}\right)^2 + 1/2 \cdot (m \cdot l^2 + 1/12 \cdot m \cdot (a^2 + b^2)) \cdot \text{diff}(\varphi(t), t)^2 + m \cdot L_2 \cdot l \cdot \frac{d\theta(t)}{dt} \cdot \frac{d\varphi(t)}{dt} \cdot \cos(\theta(t) - \varphi(t))$$

Your last answer was interpreted as follows: $\frac{1}{2} \cdot (M \cdot L_1^2 + m \cdot L_2^2) \cdot \left(\frac{d\theta(t)}{dt}\right)^2 + \frac{1}{2} \cdot (m \cdot l^2 + \frac{1}{12} \cdot m \cdot (a^2 + b^2)) \cdot \left(\frac{d\varphi(t)}{dt}\right)^2 + m \cdot L_2 \cdot l \cdot \left(\frac{d\theta(t)}{dt}\right) \cdot \left(\frac{d\varphi(t)}{dt}\right) \cdot \cos(\theta(t) - \varphi(t))$

Using your obtained expression, determine the expression for $\frac{d}{dt}(T_g)^T - (T_g)^T$:

$$\text{matrix}([(m \cdot L_2^2 + M \cdot L_1^2) \cdot \text{diff}(\frac{d\theta(t)}{dt}, t) + m \cdot l \cdot L_2 \cdot \text{diff}(\frac{d\varphi(t)}{dt}, t) \cdot \cos(\theta(t) - \varphi(t)) + m \cdot L_2 \cdot l \cdot \text{diff}(\frac{d\theta(t)}{dt}, t) \cdot \sin(\theta(t) - \varphi(t))], [(m \cdot l^2 + 1/12 \cdot m \cdot (a^2 + b^2)) \cdot \text{diff}(\frac{d\varphi(t)}{dt}, t) + m \cdot L_2 \cdot l \cdot \text{diff}(\frac{d\theta(t)}{dt}, t)])$$

Your last answer was interpreted as follows: $\begin{bmatrix} (m \cdot L_2^2 + M \cdot L_1^2) \cdot \left(\frac{d}{dt}\frac{d\theta(t)}{dt}\right) + m \cdot l \cdot L_2 \cdot \left(\frac{d}{dt}\frac{d\varphi(t)}{dt}\right) \cdot \cos(\theta(t) - \varphi(t)) + m \cdot L_2 \cdot l \cdot \left(\frac{d}{dt}\frac{d\theta(t)}{dt}\right) \cdot \sin(\theta(t) - \varphi(t)) \\ (m \cdot l^2 + \frac{1}{12} \cdot m \cdot (a^2 + b^2)) \cdot \left(\frac{d}{dt}\frac{d\varphi(t)}{dt}\right) + m \cdot l \cdot L_2 \cdot \left(\frac{d}{dt}\frac{d\theta(t)}{dt}\right) \cdot \cos(\theta(t) - \varphi(t)) + (-m) \cdot l \cdot L_2 \cdot \left(\frac{d}{dt}\frac{d\theta(t)}{dt}\right) \cdot \sin(\theta(t) - \varphi(t)) \end{bmatrix}$

In the coupling point C , some friction is present, which can be modeled as a torsional viscous damper with damping constant b . Furthermore, wind acting on the gondola is modeled as an external force F acting on point G in \vec{e}_z . Give the expression for the non-conservative generalized forces \underline{Q}_{nc} :