**Motivation**

Guaranteeing the correctness of cyber-physical systems (CPS) remains an outstanding challenge.

Xi Zheng et al., 2014

"Simulation alone is not sufficient to support verification and validation of CPS" Sayan Mitra et al., 2013

\[
x(k + 1) = Ax(k) + Bu(k)
\]
\[
y(k) = Cx(k) + Du(k)
\]

State-space model

\[
H(z) = b_0 + b_1 z^{-1} + \ldots + b_m z^{-m}
\]
\[
a_0 + a_1 z^{-1} + \ldots + a_n z^{-n}
\]

Transfer-function model

**Approach and Uniqueness**

**Counter-Example Guided Inductive Synthesis (CEGIS)**

Generate sound digital controllers for stability and safety specifications with a very high degree of automation.

**Steps 1 and 2**

1. Determine the representation
   - State-space model
   - Transfer-function model

2. Define the physical plant coefficients and intervals
   - State-space: matrices A, B, C, and D
   - Transfer-function: coefficients \( b_0, b_1, \ldots, b_m \) and \( a_0, a_1, \ldots, a_n \)
   - Uncertainty over the numerator and denominator coefficients

3. Define the numerical representation
   - \( I \) is the integer part
   - \( F \) is the fractional part
   - Dynamical range

**Step 3**

1. Support for transfer-function and state-space representations in closed-loop form;
2. Synthesize different numerical representations and realization forms of the controller using CEGIS;
3. Provide a MATLAB toolbox to synthesize digital controllers while taking into account FWL effects.

As future work:
- DSSynth Toolbox will perform synthesis considering performance requirements;
- We will also pursue the application of CEGIS to further software engineering problems.