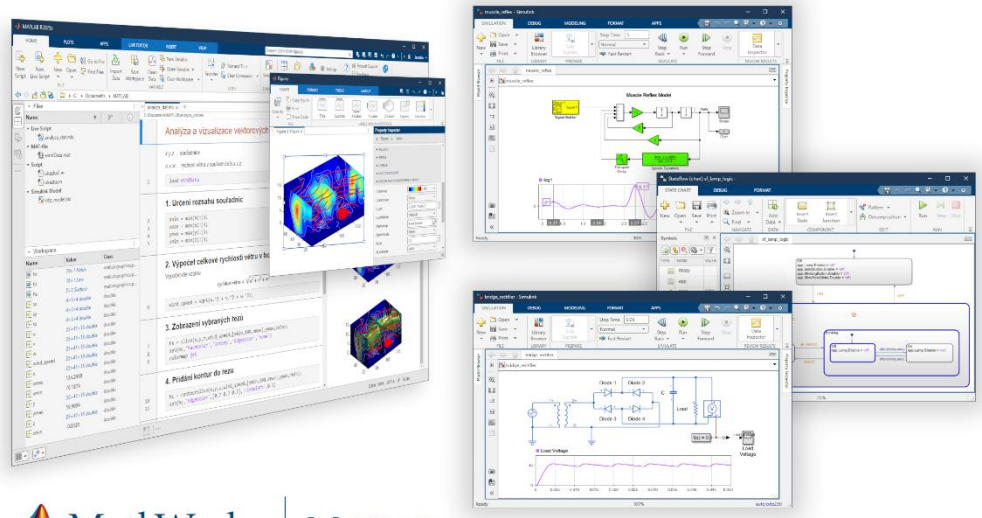
HUMUSOFT®

Modelovanie a simulácia nadriadenej riadiacej logiky



MathWorks® Authorized Reseller | MATLAB® & SIMULINK®

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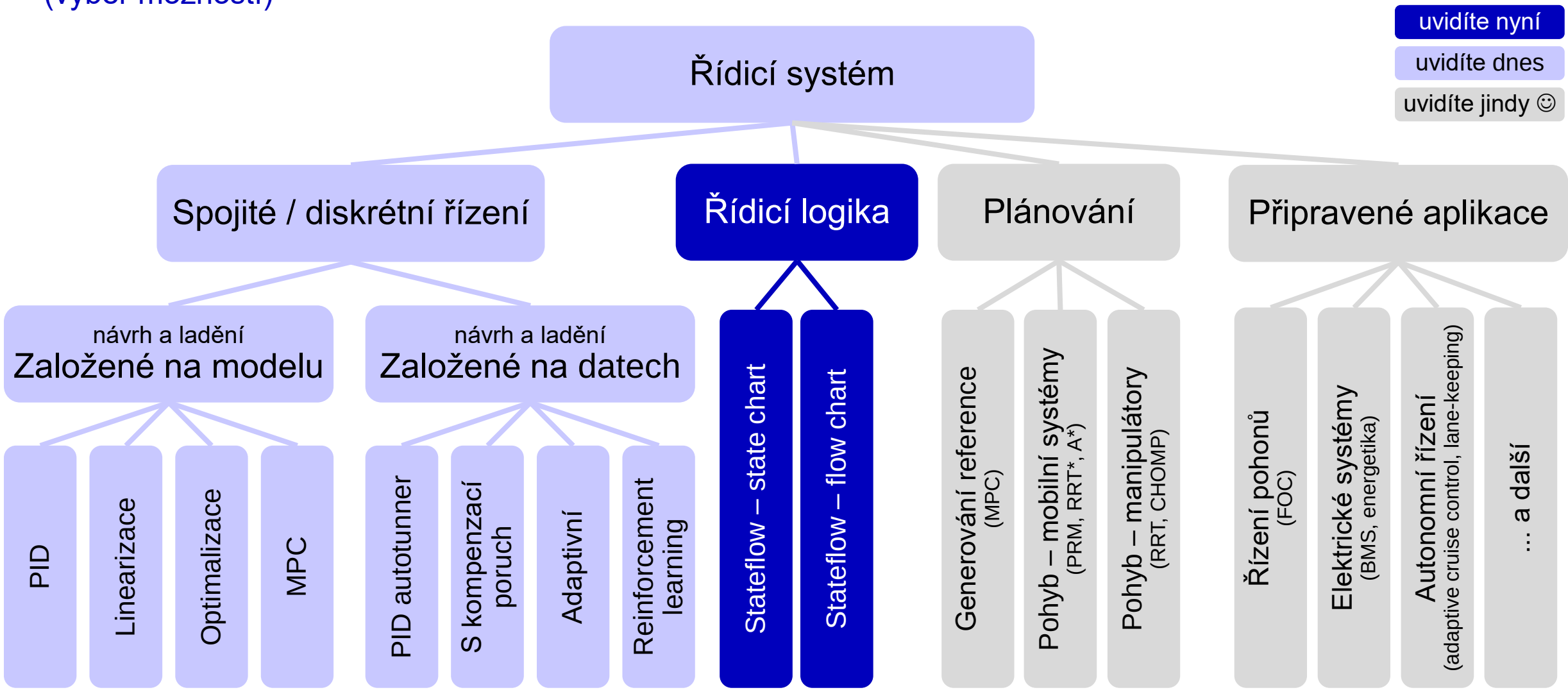
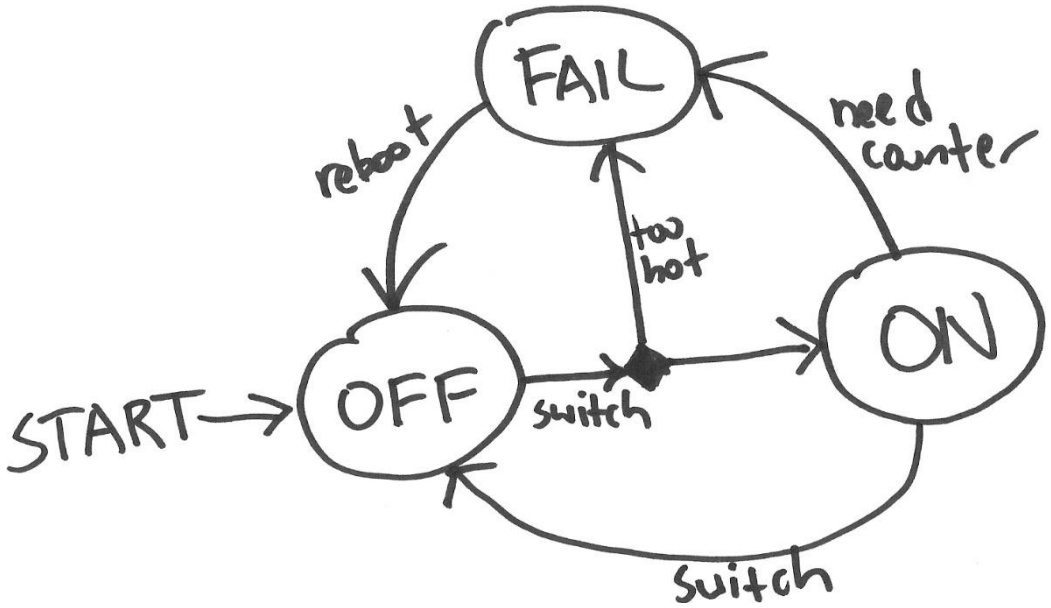
Možnosti návrhu řídicích systémů v prostředí MATLAB

(výběr možností)



Čo je stavový automat

- Modelovanie rôznych stavov, v ktorých sa môže systém nachádzať a ako sa prechádza medzi týmito stavmi na základe vstupov alebo udalostí



Stavové automaty sú všade

Riadenie dopravy

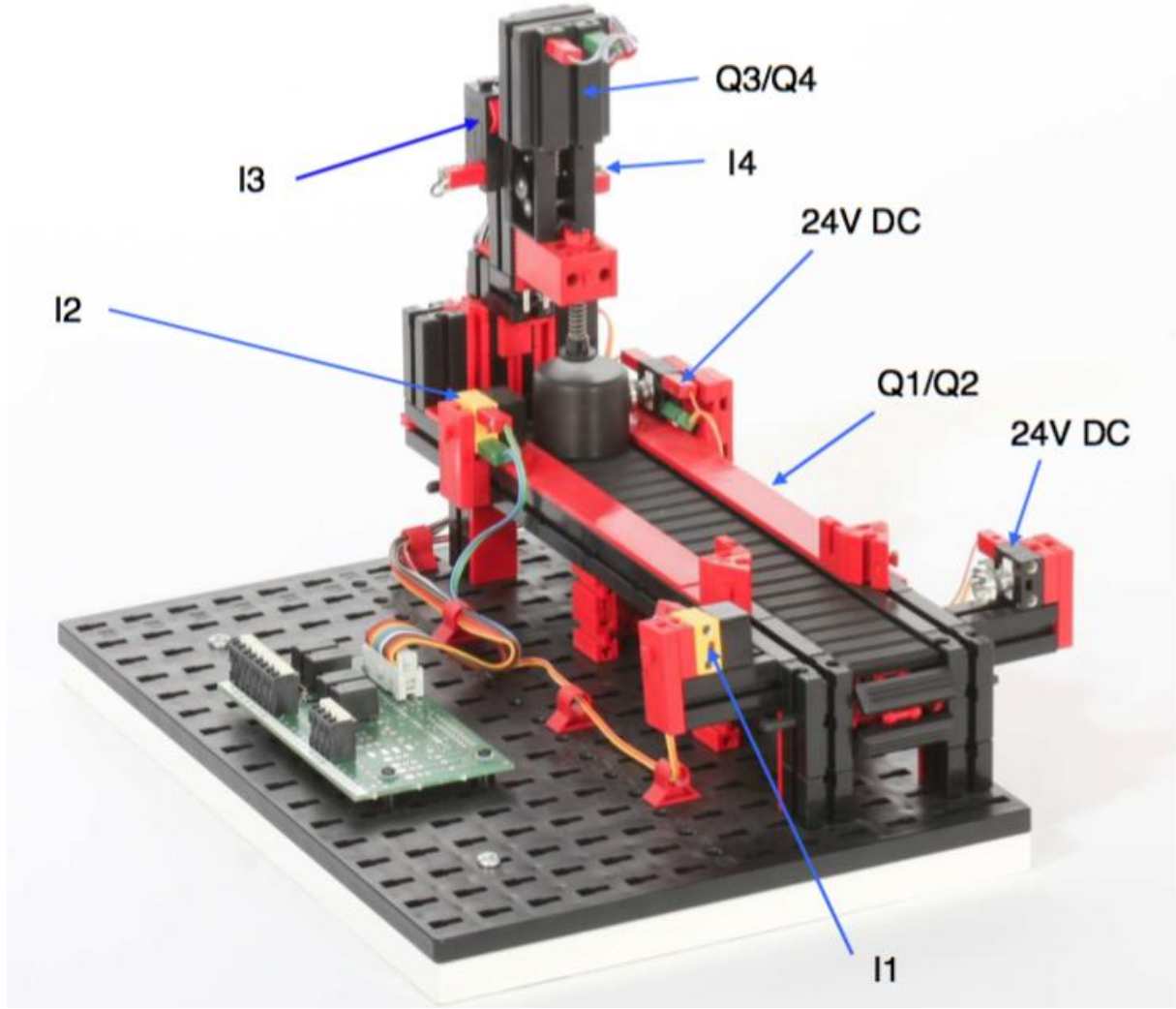
Automobily

Letectvo

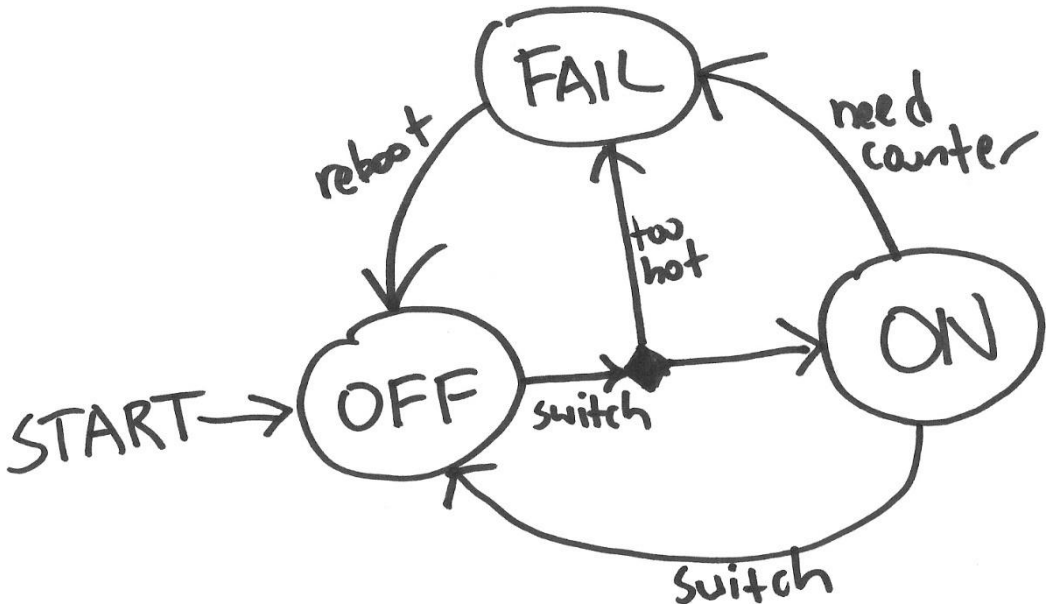
Výrobné systémy

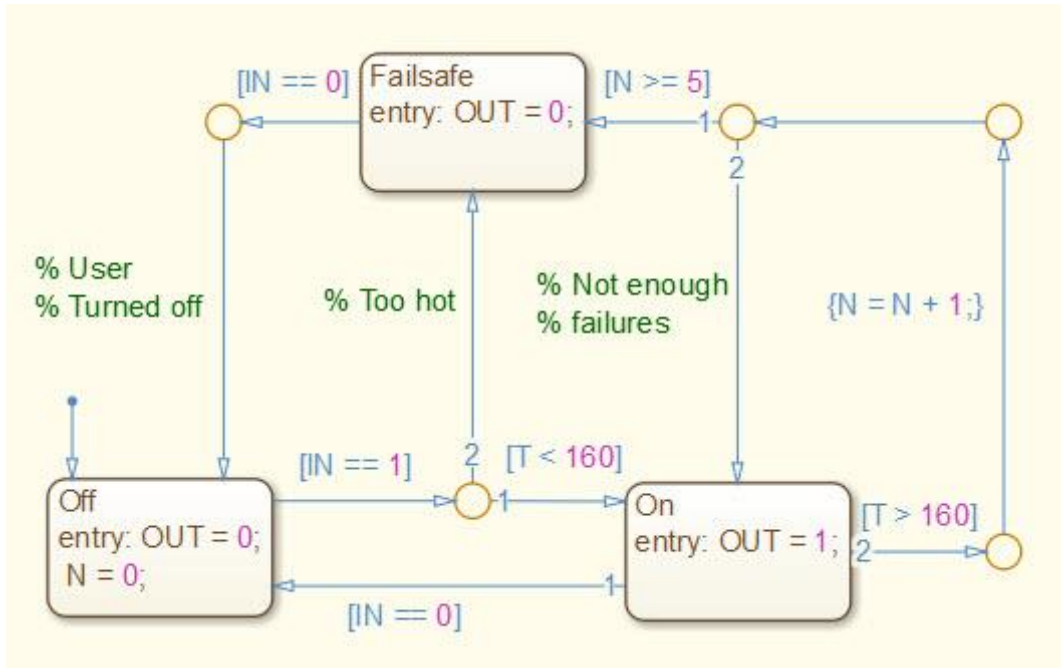
Ukážka: Model výrobnej linky

- Jednoduchý výrobný proces
  - posúvanie výrobku po dopravníku
  - opracovanie výrobku portálom
- Motory
  - pohyb dopravníka
  - pohyb portálu
- Snímače
  - kraje dopravníka
  - kraje portálu
- Cieľ
  - tvorba riadenia – stavový automat



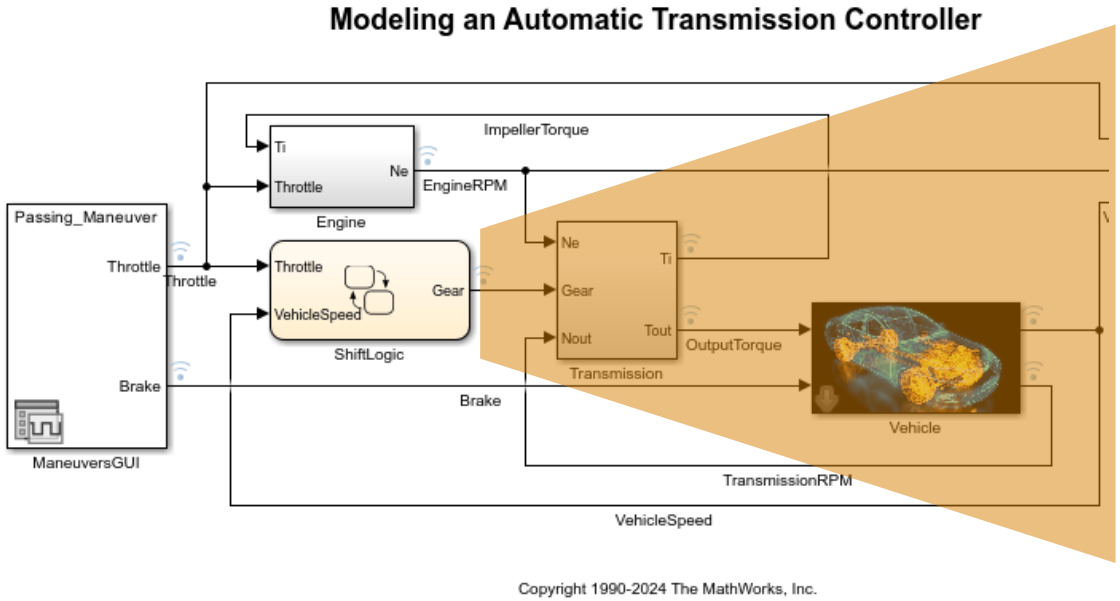
Stateflow je prostredie pre návrh stavových automatov

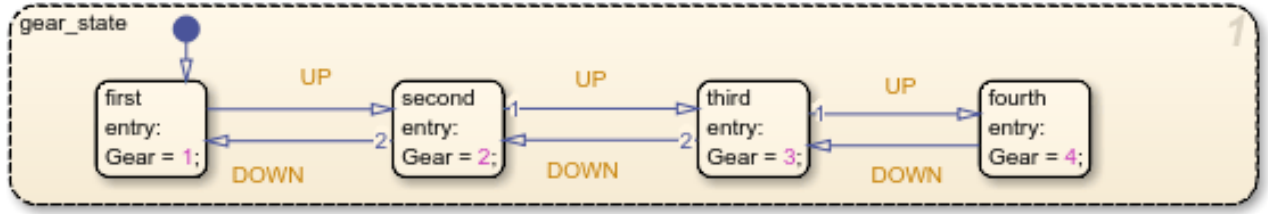


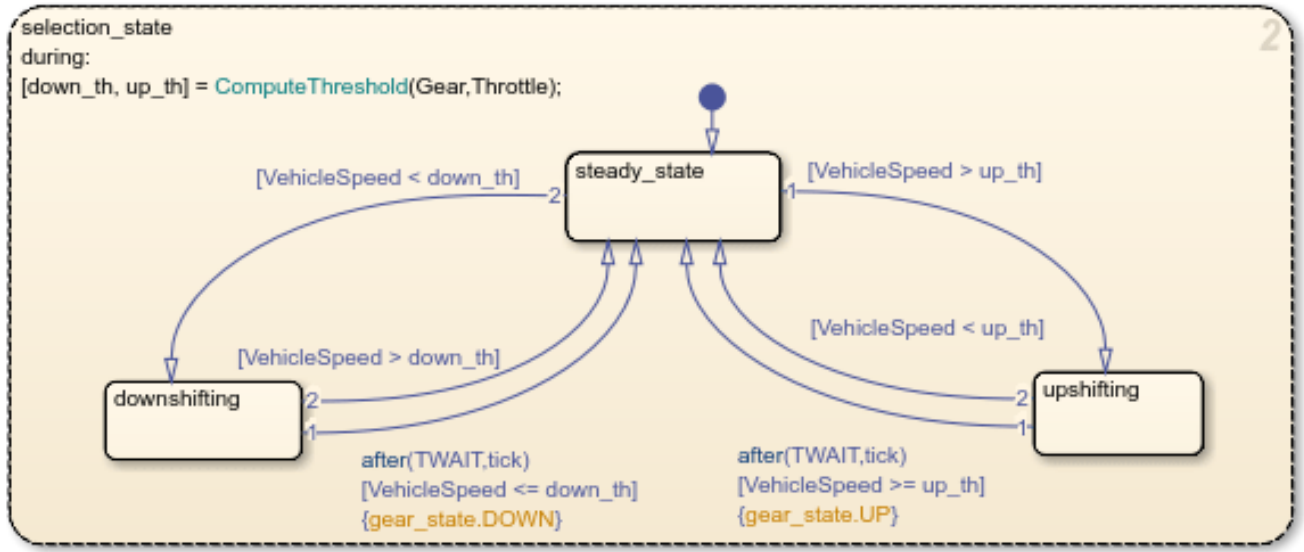


Prečo tvoriť stavové automaty v prostredí Stateflow?

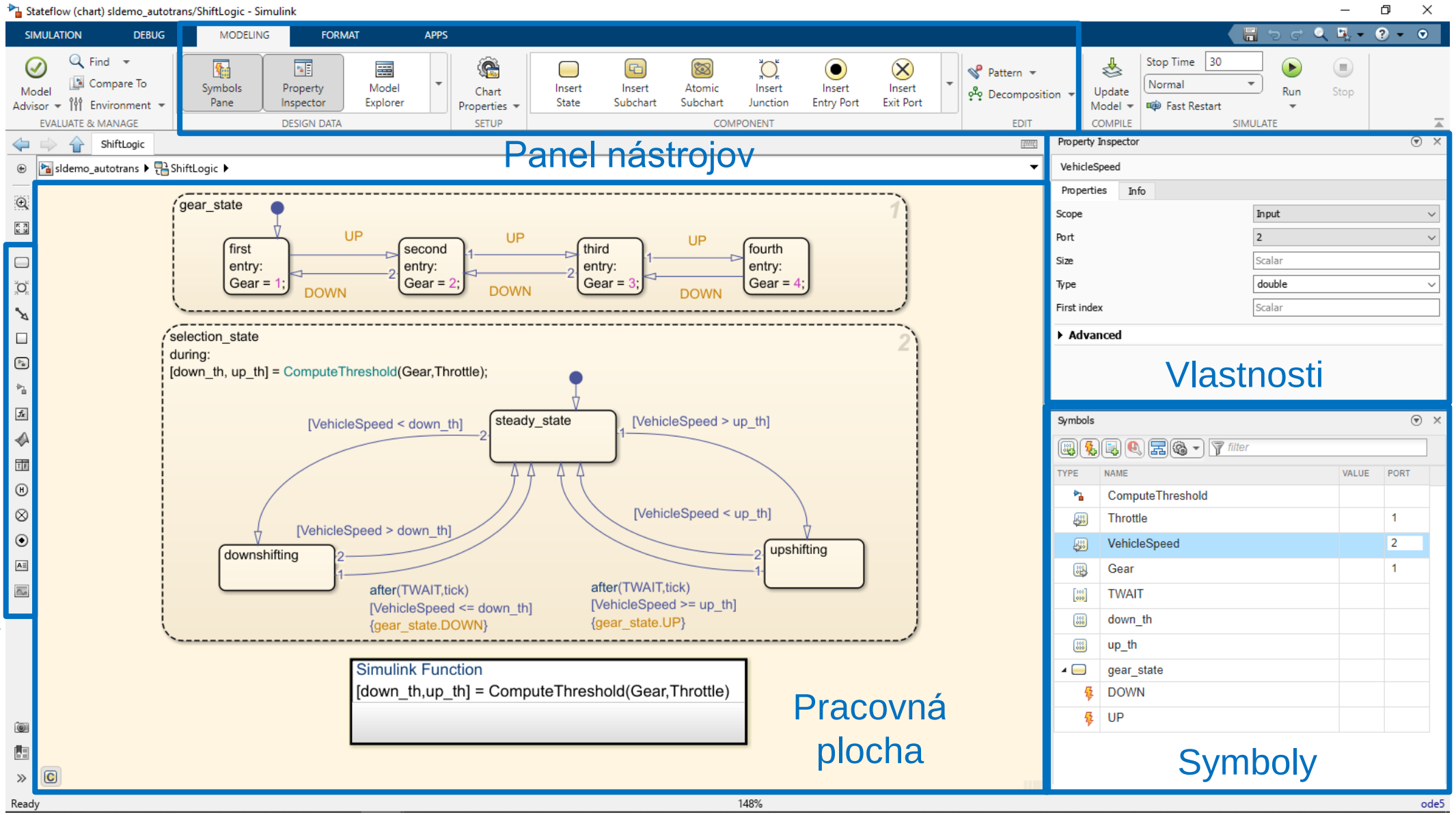
Integrácia so Simulinkom



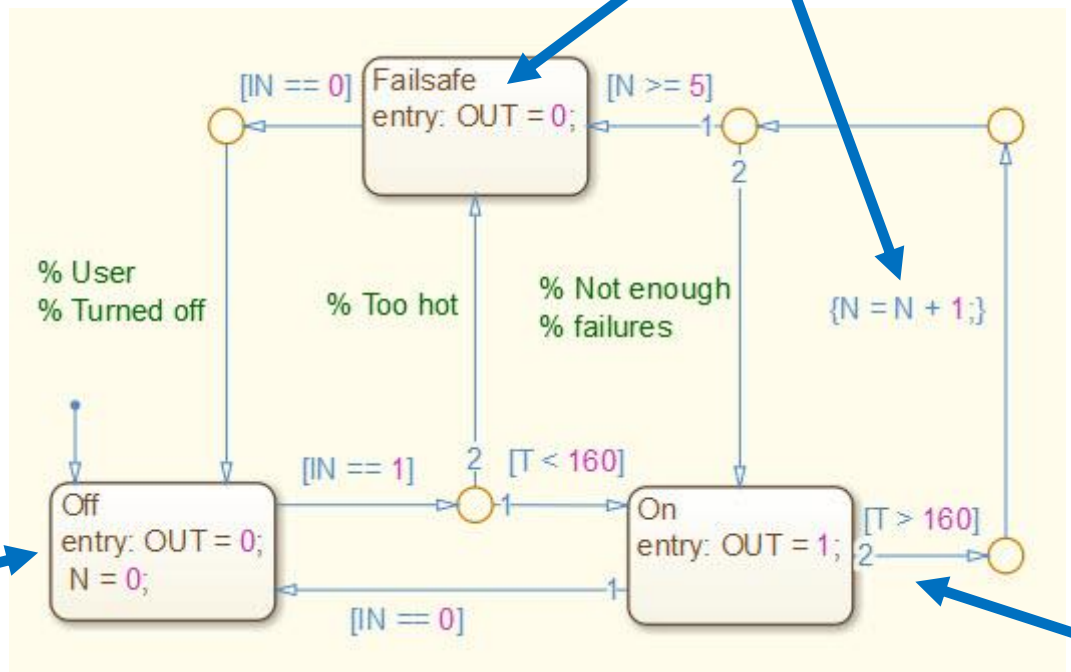




Vizuálne modelovanie v intuitívnom prostredí

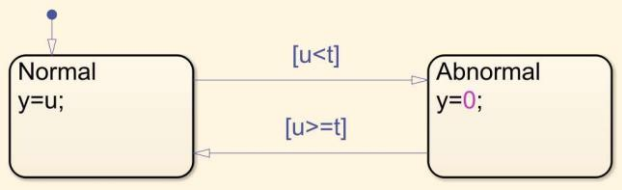


Prehľadné modelovanie stavového automatu



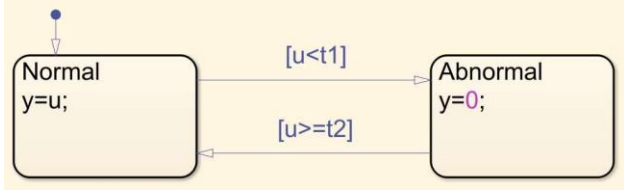
Stateflow zostáva kompaktný

jednoduchá logika



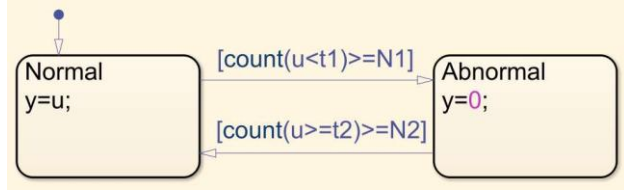

```
for i = 1:length(inData)
    if(inData(i) >= t)
        outData(i) = inData(i);
    else
        outData(i) = 0;
    end
end
```

+ hysteréza




```
inNormalRegion = true;
for i = 1:length(inData)
    if(inNormalRegion && (inData(i)<t1))
        inNormalRegion = false;
    elseif(~inNormalRegion && (inData(i)>=t2))
        inNormalRegion = true;
    end
    if(inNormalRegion)
        outData(i) = inData(i);
    else
        outData(i) = 0;
    end
end
```

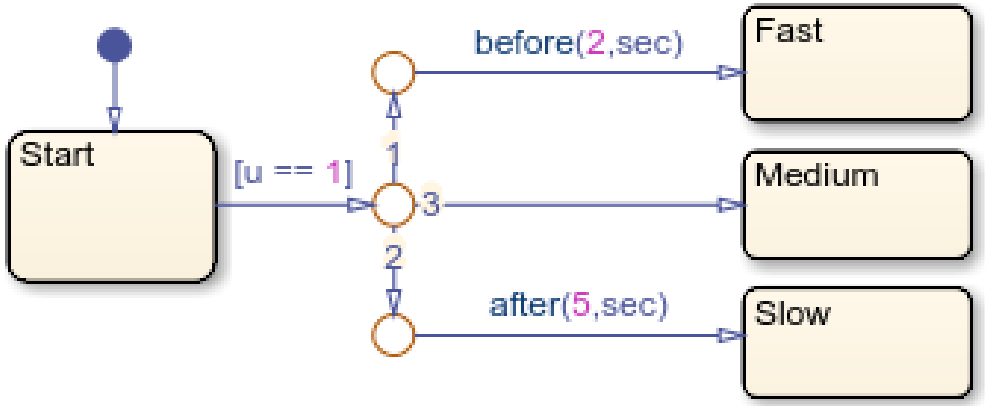
+ hysteréza + ošetrenie zákmitov




```
inNormalRegion = true;
counter = 0;
for i=1:length(inData)
    if(inNormalRegion)
        if(inData(i)<t1)
            counter = counter+1;
            if(counter>=N1)
                inNormalRegion = false;
            end
        else
            counter = 0;
        end
     else
        if(inData(i)>=t2)
            counter = counter+1;
            if(counter>=N2)
                inNormalRegion = true;
            end
        else
            counter = 0;
        end
     end
     if(inNormalRegion)
        outData(i) = inData(i);
    else
        outData(i) = 0;
    end
end
```

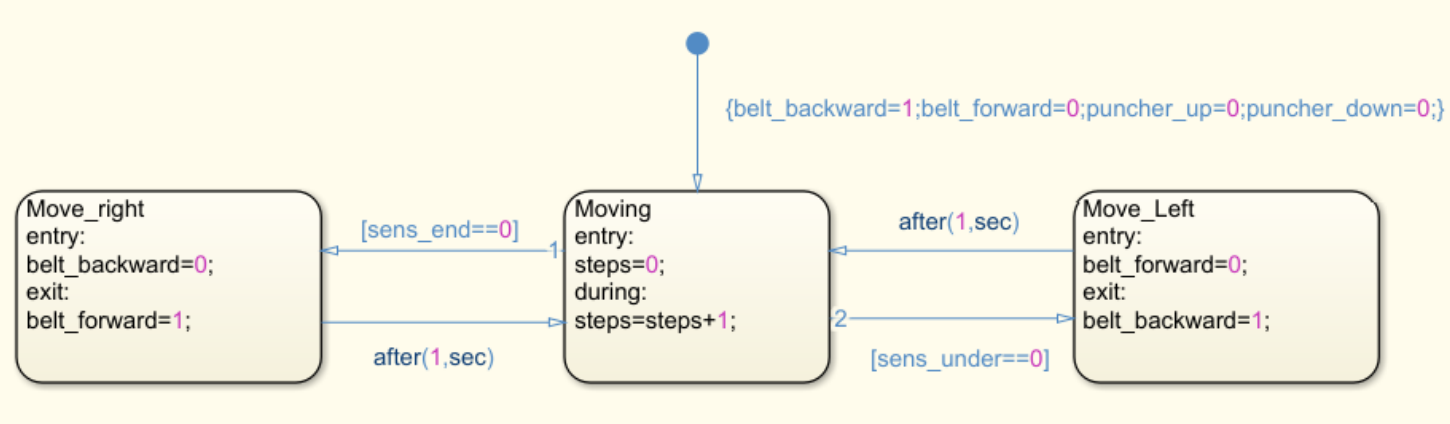
Flexibilná práca s udalosťami a časom

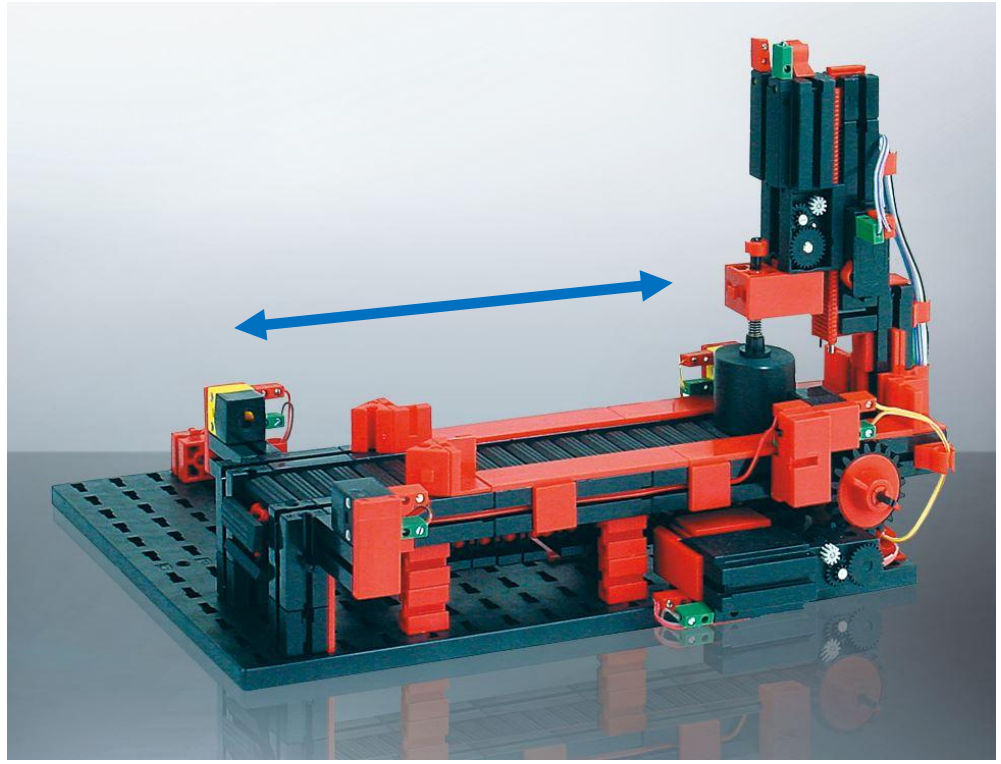
- Operátory – *after, at, before, every, count, temporalCount, duration, elapsed*
  - explicitné a implicitné udalosti – after(n,E), before(n,tick)
  - absolútny čas (sec, msec, usec) – after(n,sec)



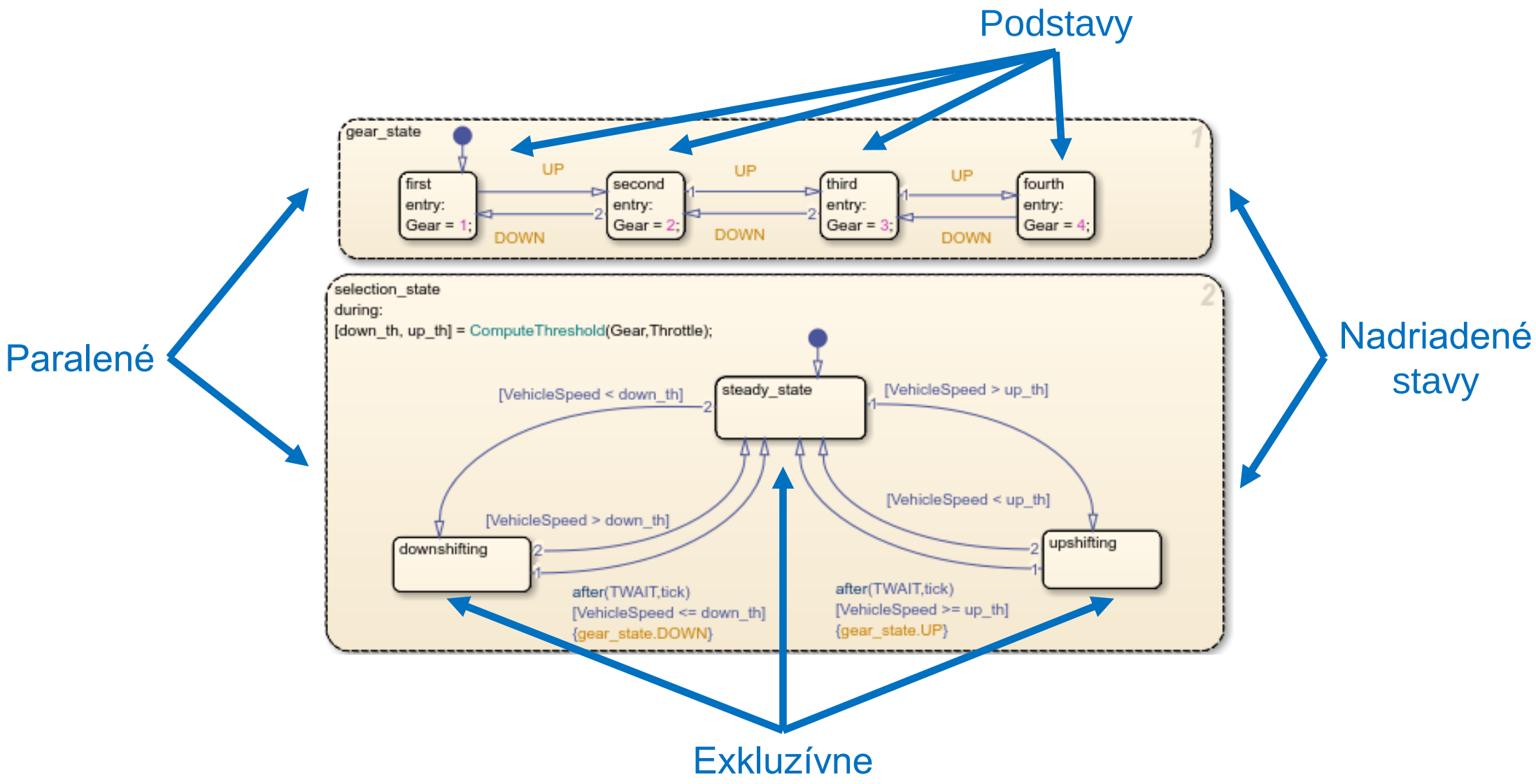
Ukážka: Základný pohyb dopravníka

- Pohyb výrobku zo strany na stranu



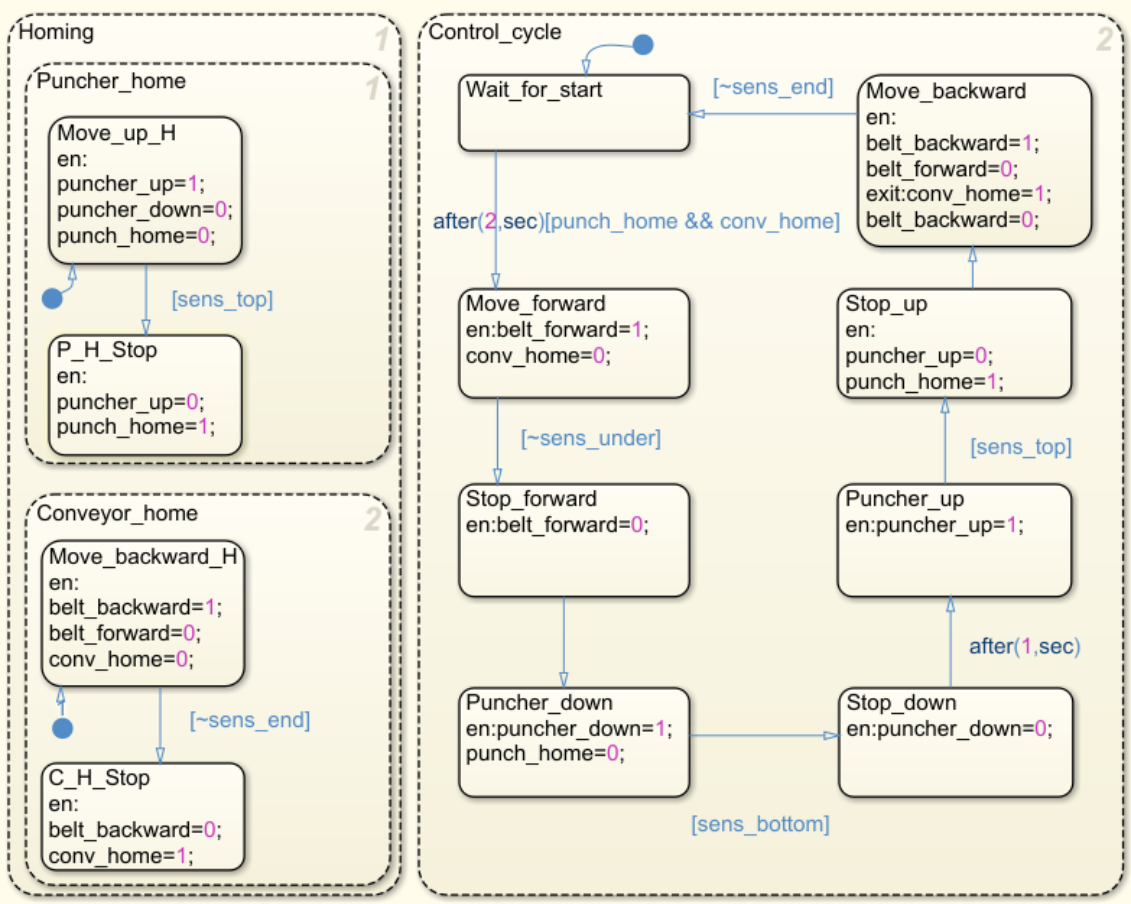


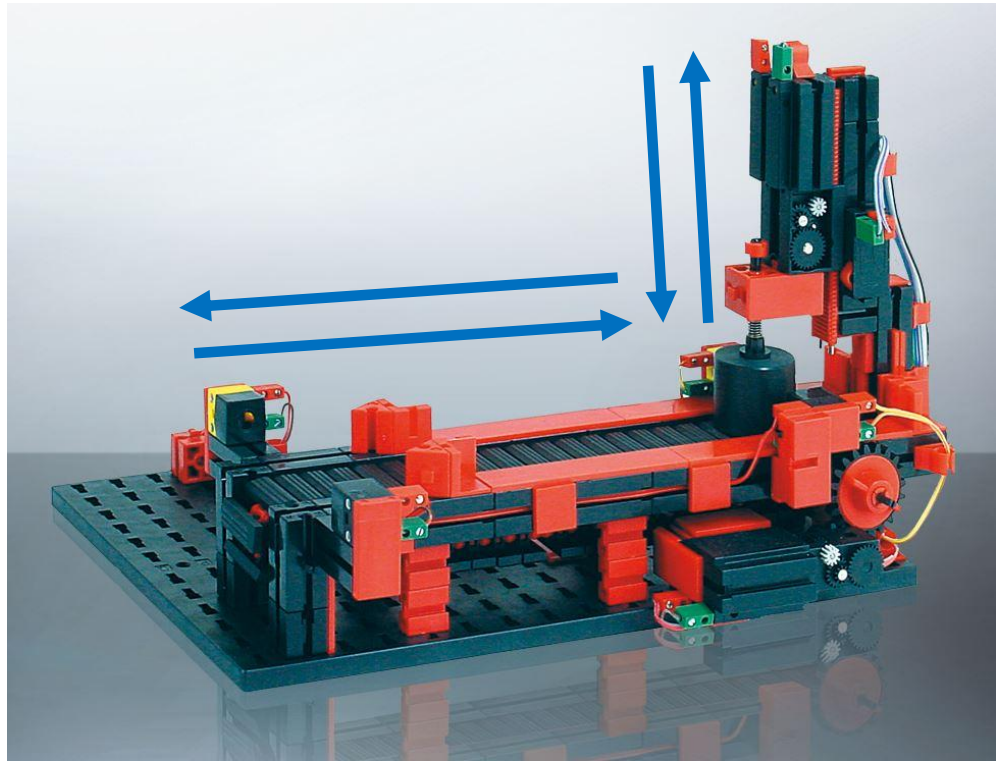
Tvorba komplexných stavových systémov



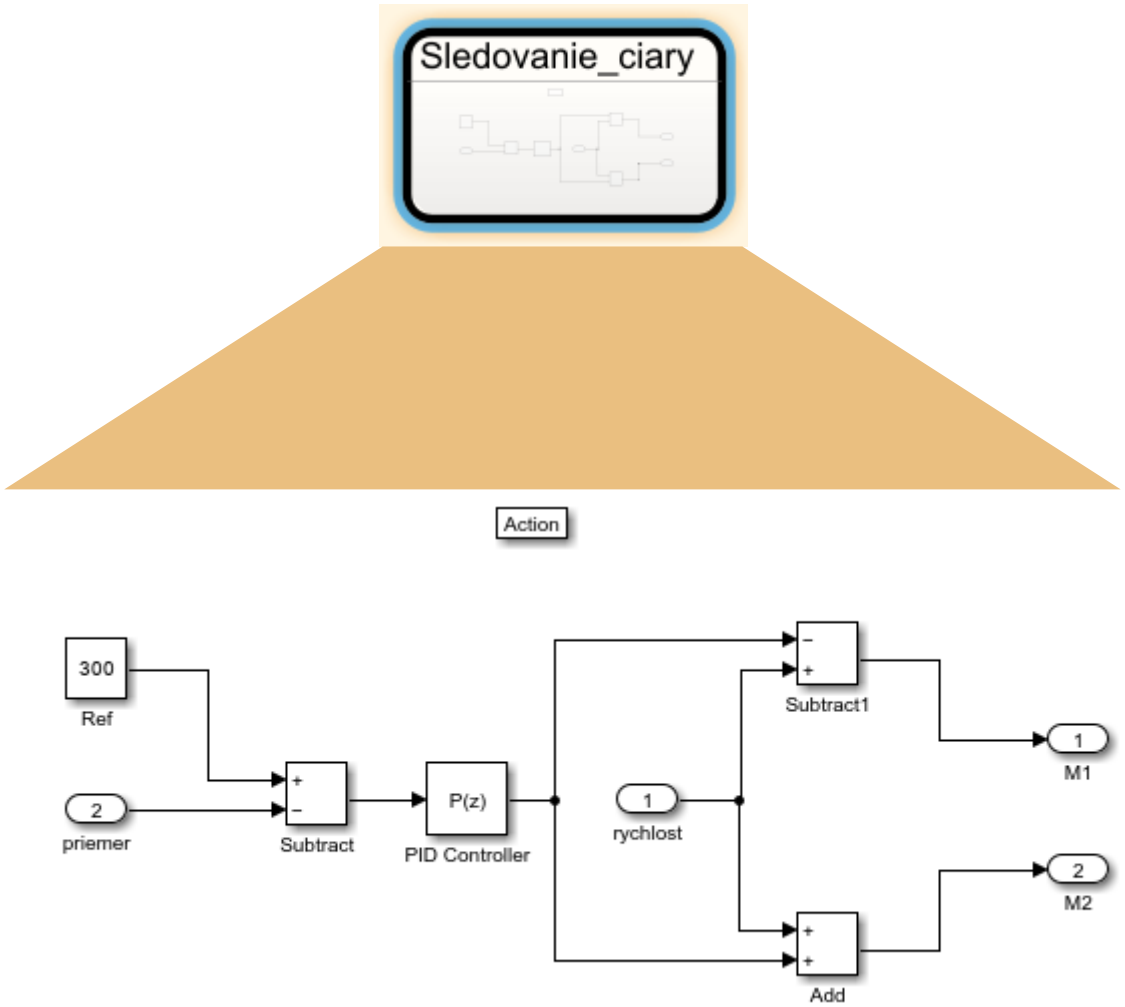
Ukážka: Komplexný pohyb dopravníka

- Presun do počiatočných polôh a výrobný proces

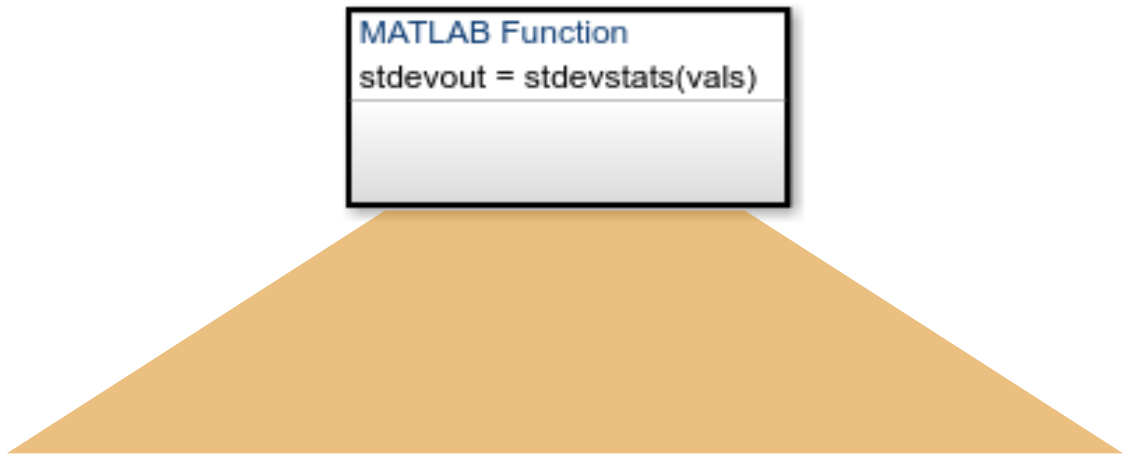




Stavy pomocou blokov a kód prostredia MATLAB



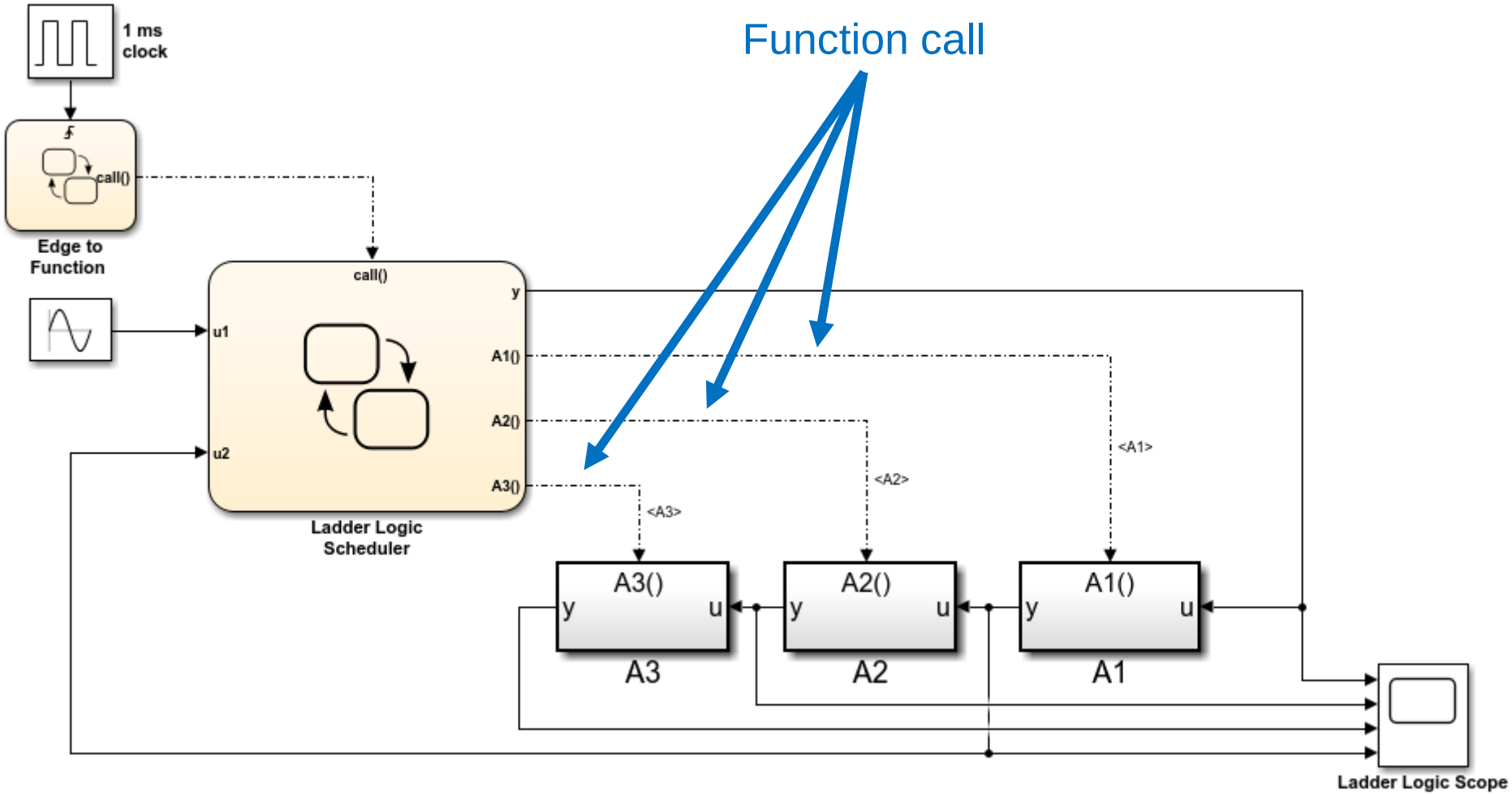
Simulink State



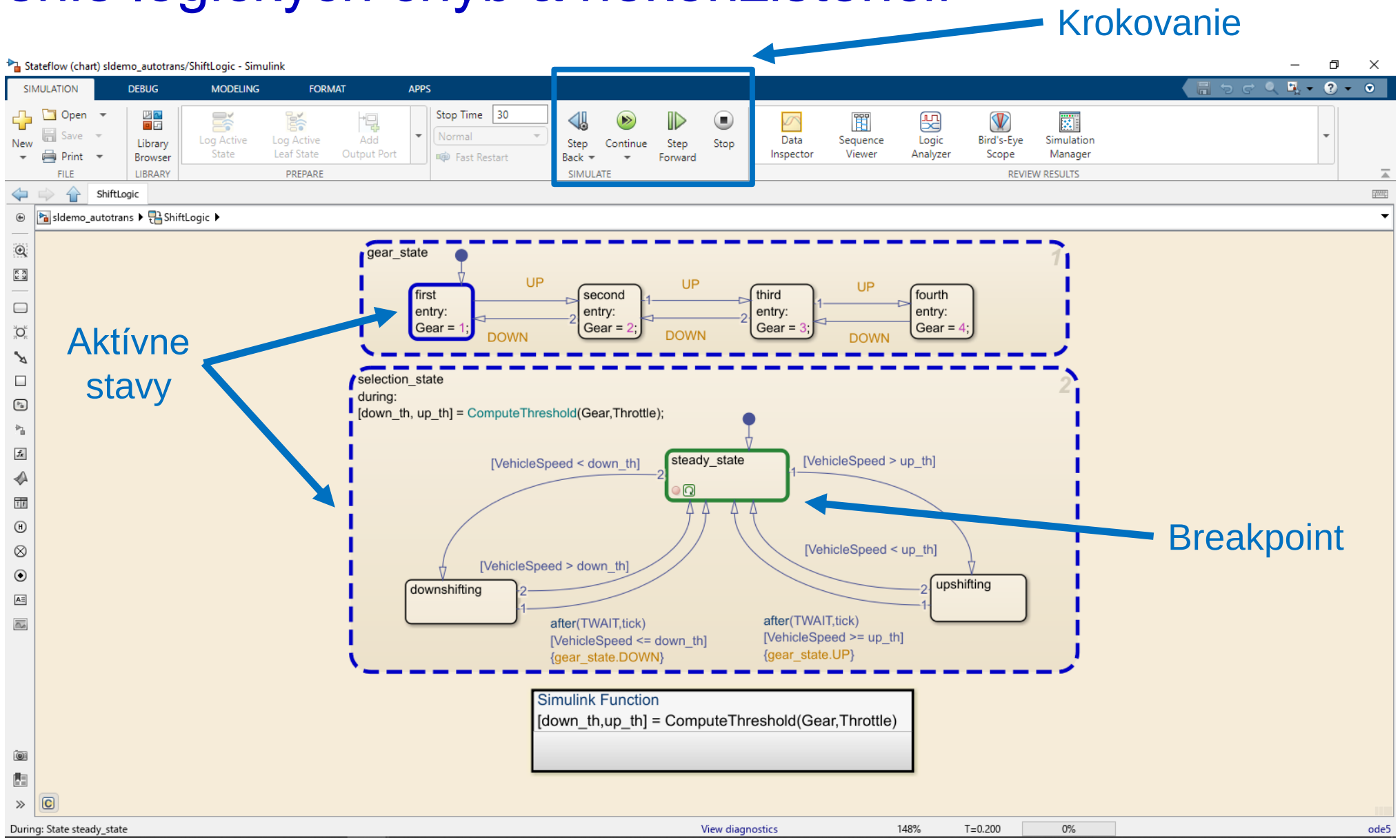

```
function stdevout = stdevstats(vals)
%#codegen

% Calculates the standard deviation for vals

len = length(vals);
stdevout = sqrt(sum(((vals-avg(vals,len)).^2))/len);

function mean = avg(array,size)
mean = sum(array)/size;
```

MATLAB function

Riadenie subsystémov

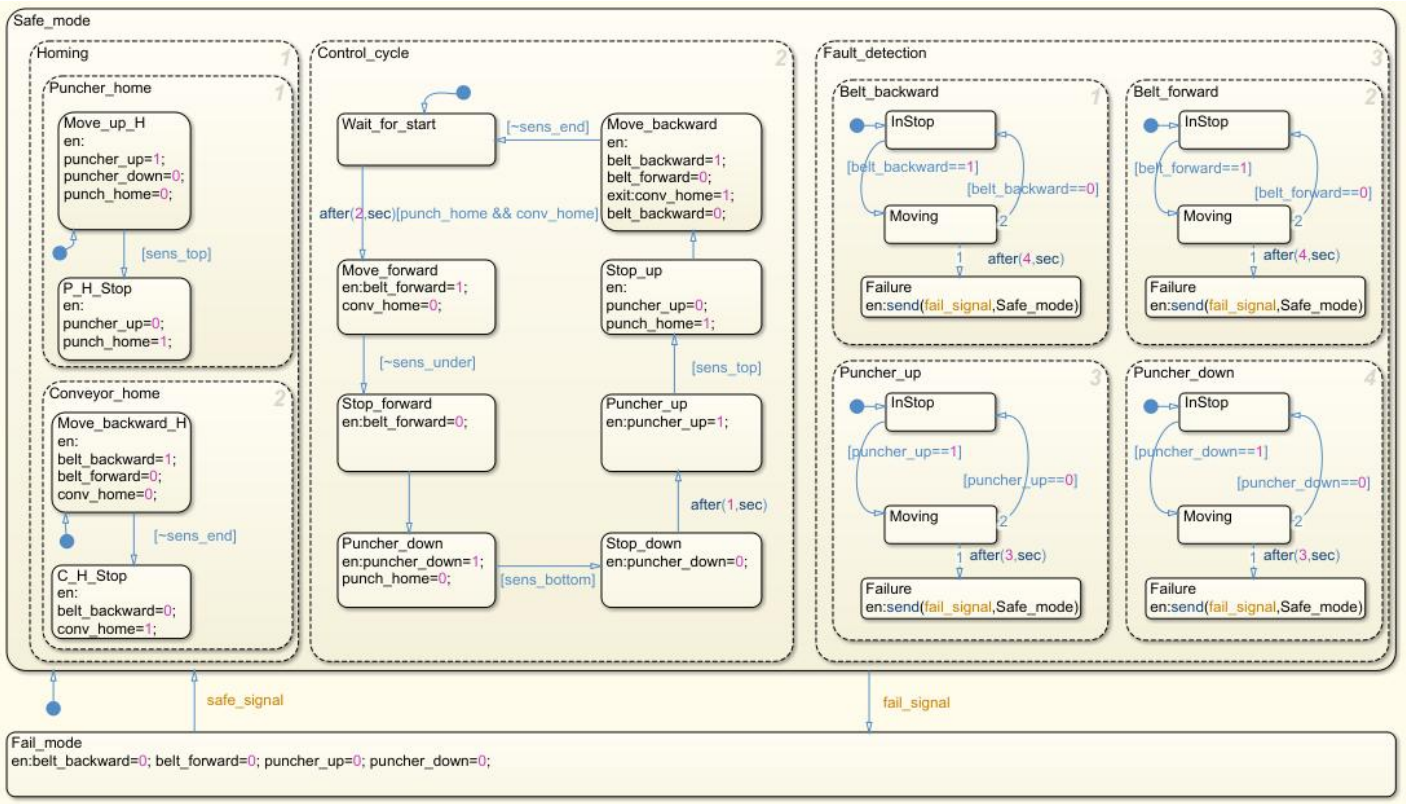


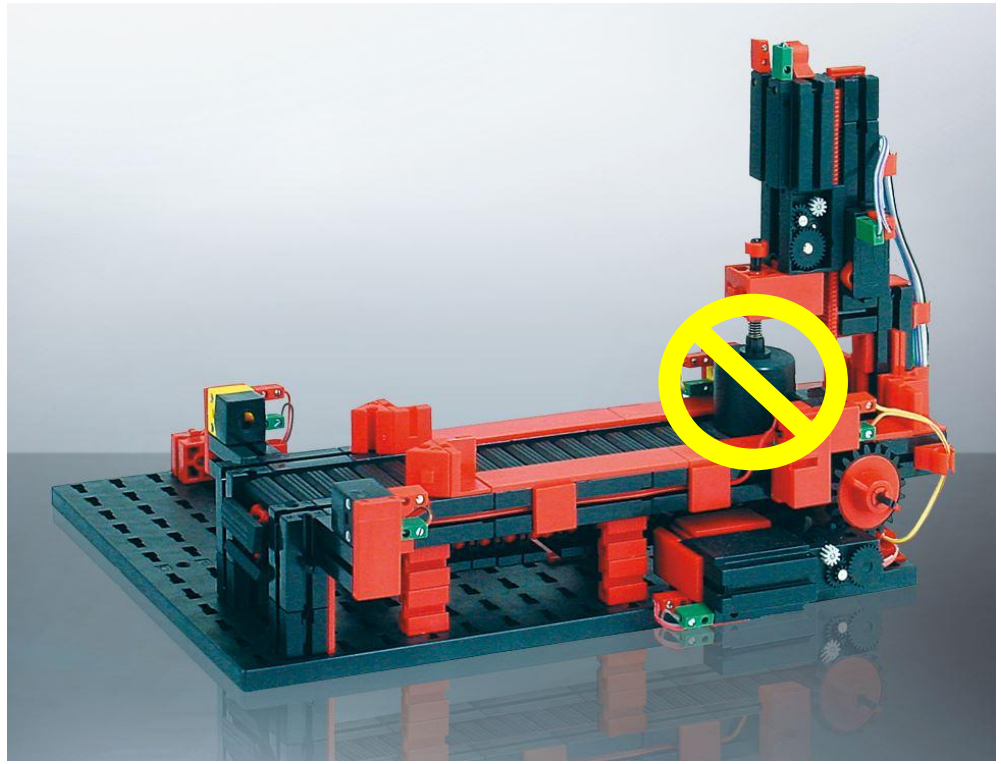
Ladenie logických chýb a nekonzistencií



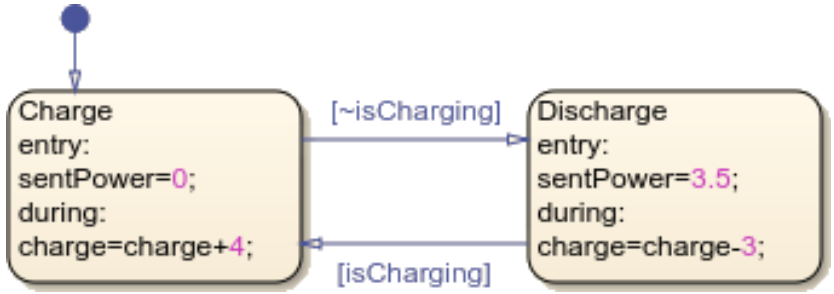
Ukážka: Reakcia na poruchu

- Chýbajúci alebo zaseknutý výrobok

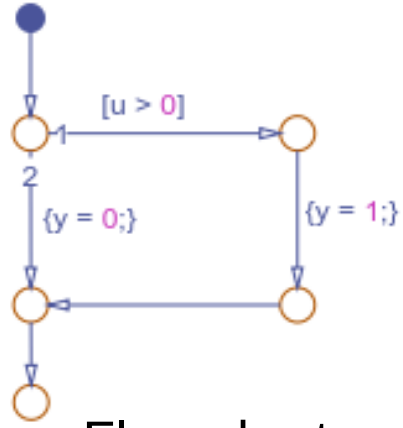




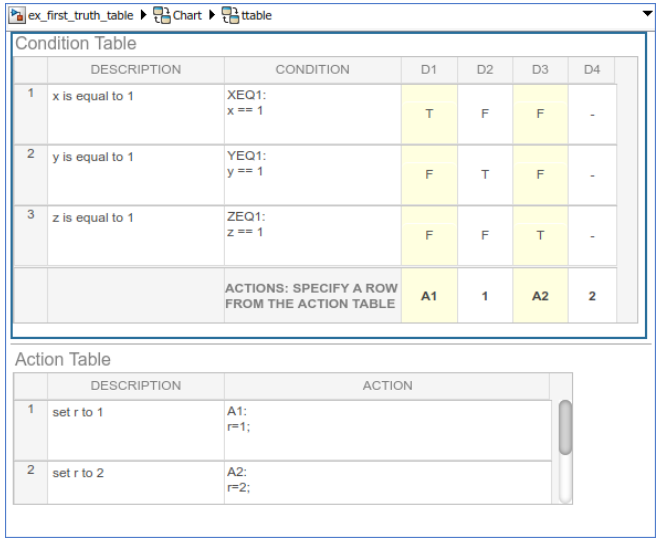
Viaceré prístupy modelovania



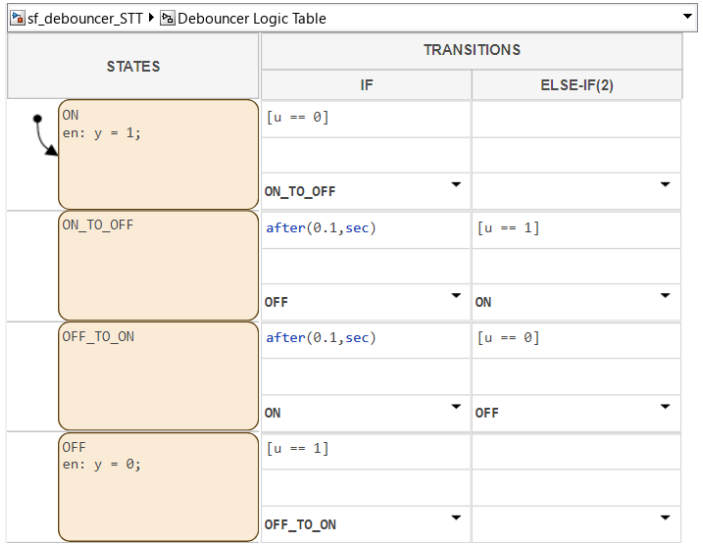
Chart



Flow chart

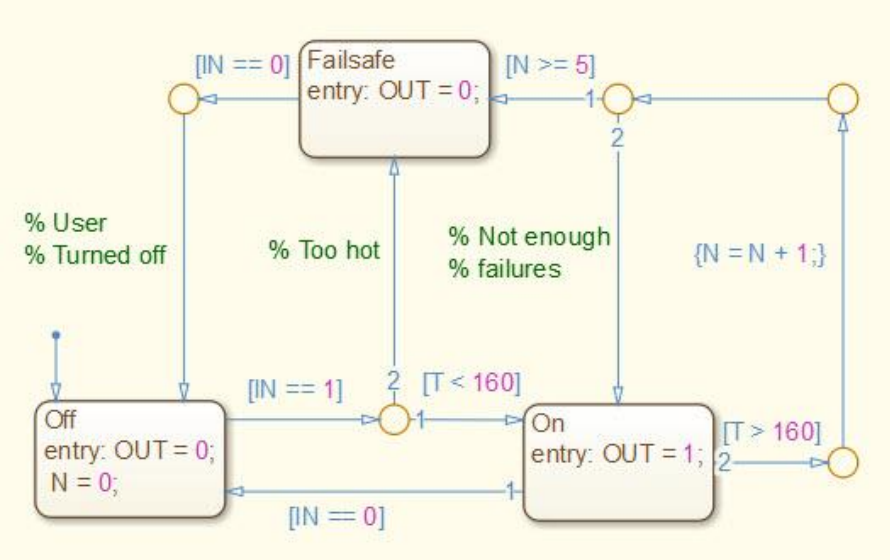


Truth Table

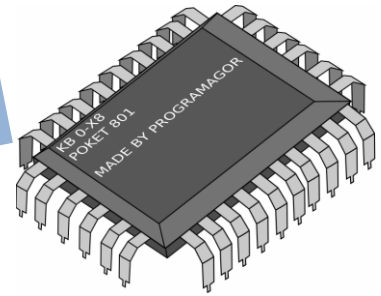


State Transition Table

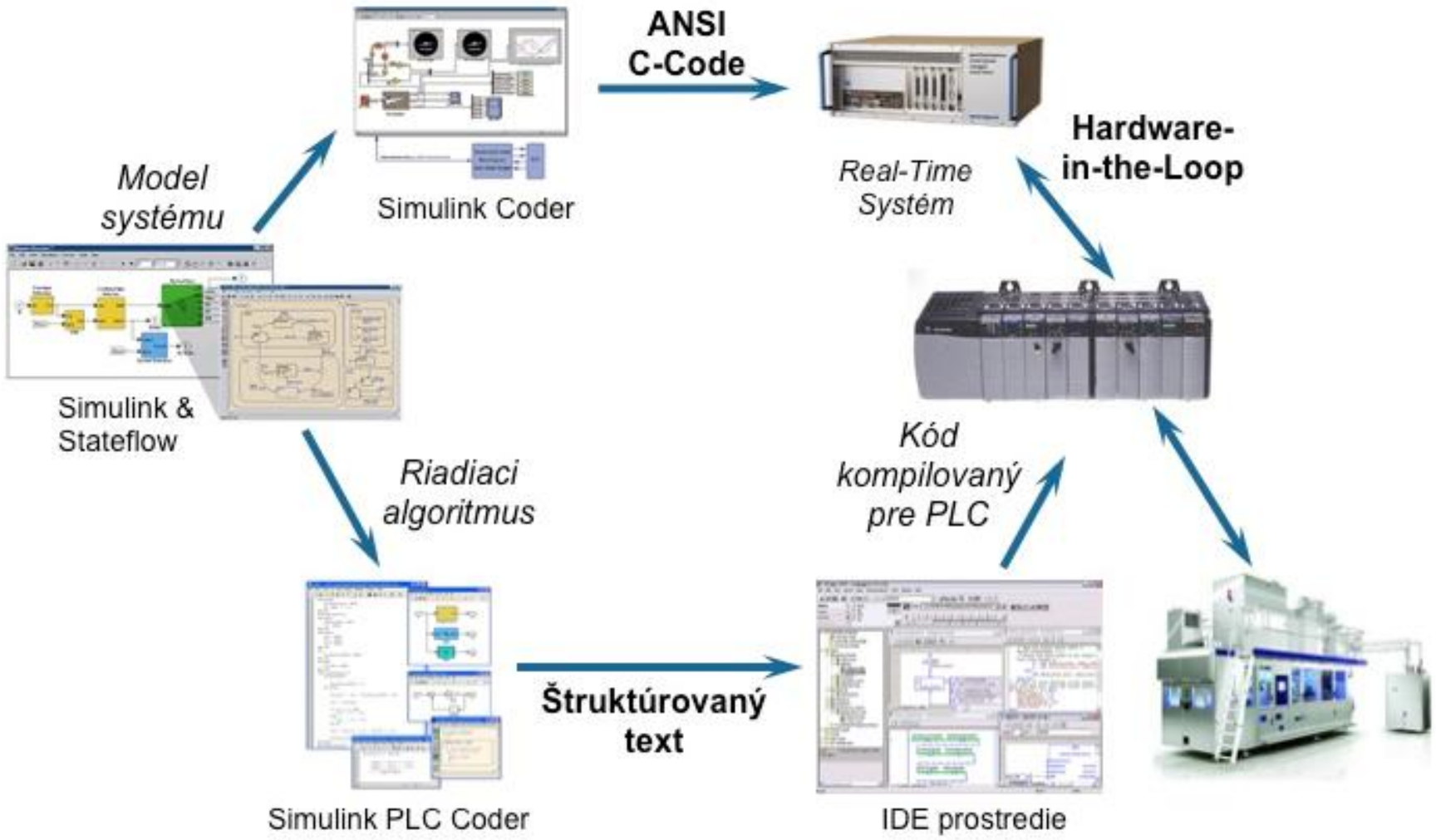
Rýchly prechod od návrhu k nasadeniu




```
/* Model step function */
void Chart_step(void)
{
  /* Chart: '<Root>/Chart' incorporates:
   *  Inport: '<Root>/IN'
   *  Inport: '<Root>/T'
   */
  /* Gateway: Chart */
  /* During: Chart */
  if (Chart_DWork.is_active_c3_Chart == 0U) {
    /* Entry: Chart */
    Chart_DWork.is_active_c3_Chart = 1U;

    /* Entry Internal: Chart */
    /* Transition: '<S1>:137' */
    Chart_DWork.is_c3_Chart = Chart_IN_Off;

    /* Outport: '<Root>/OUT' */
    /* Entry 'Off': '<S1>:125' */
    Chart_Y.OUT = 0.0;
    Chart_DWork.N = 0.0;
  } else {
    switch (Chart_DWork.is_c3_Chart) {
     case Chart_IN_Failsafe:
      /* During 'Failsafe': '<S1>:138' */
      if (Chart_U.switch_on == 0.0) {
        /* Transition: '<S1>:129' */
        /* Transition: '<S1>:123' */
        /*  User */
        /*  Turned off */
        Chart_DWork.is_c3_Chart = Chart_IN_Off;
```

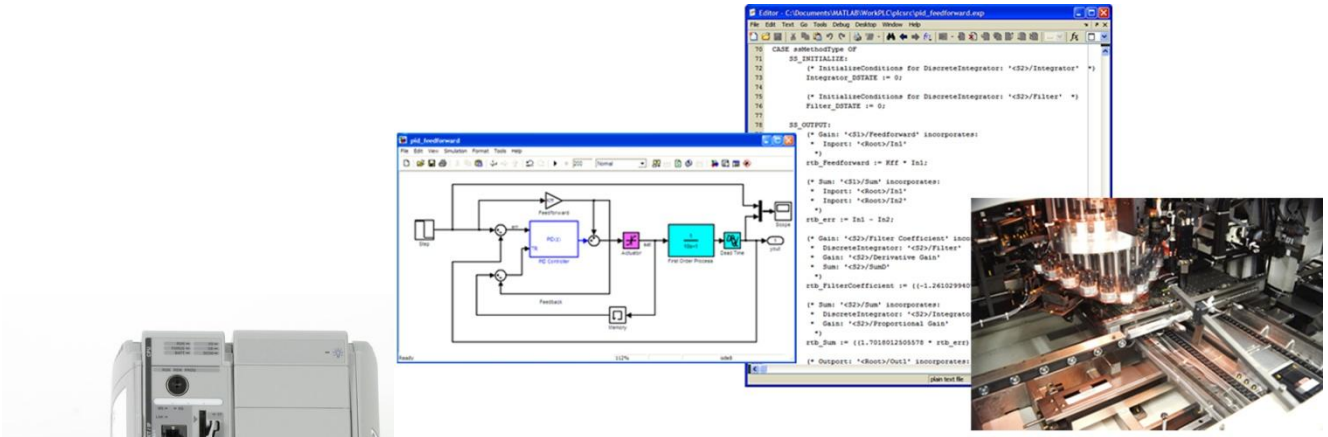


Rýchly prechod od návrhu k nasadeniu



Simulink PLC Coder

- IEC 61131-3 štruktúrovaný text
  - MATLAB
  - Simulink
  - Stateflow
- Podpora rôznych výrobcov
  - Rockwell Automation Studio 5000
  - Siemens STEP 7/TIA Portal
  - B&R Automation Studio
  - Beckhoff TwinCAT
  - PLCopen XML, Generic File Format
  - a ďalšie IDE a PLC

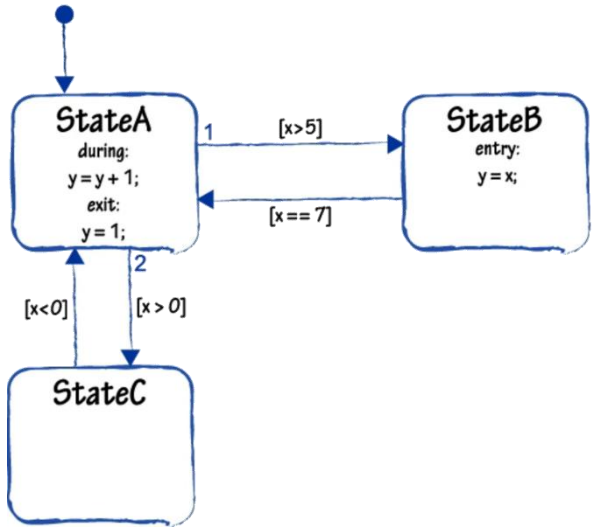


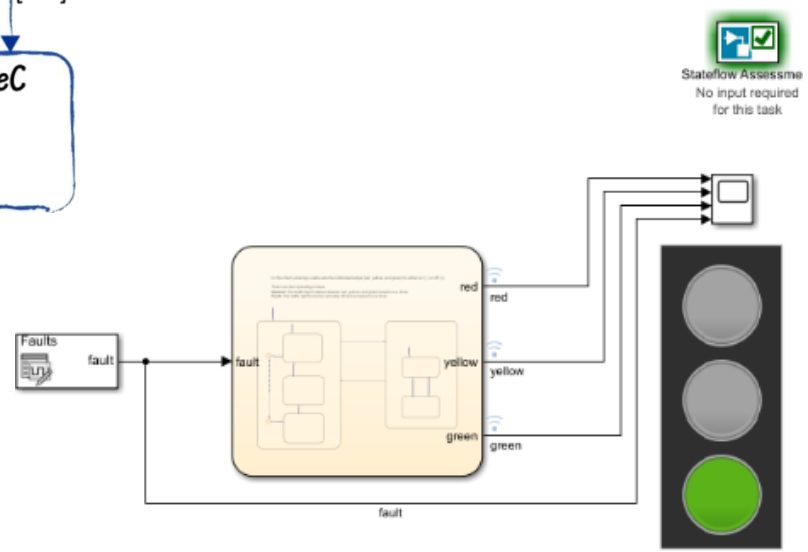
Prečo tvoriť stavové automaty v prostredí Stateflow?

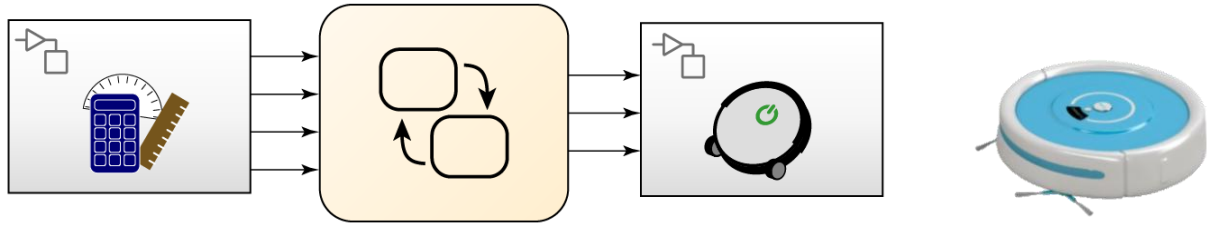
- ✓ Integrácia so Simulinkom
- ✓ Vizuálne modelovanie v intuitívnom prostředí
- ✓ Prehľadné modelovanie stavového automatu
- ✓ Kompaktnosť modelu
- ✓ Flexibilná práca s udalosťami a časom
- ✓ Tvorba komplexných stavových systémov
- ✓ Nadradená logika – riadenie subsystémov
- ✓ Ladenie logických chýb a nekonzistencií
- ✓ Rýchly prechod od návrhu k nasadeniu

Stateflow Onramp

- Bezplatný, krátky kurz základov
- Krátke videá a praktické cvičenia
- Automatizované hodnotenia a okamžitá spätná väzba
- Obsahuje témy:
  - Stavové automaty a ich tvorba
  - Akcie a ich vykonávanie
  - Flow charts
  - Funkcie v Stateflow
  - Hierarchia stavov







Verejné školenia

naučte sa ovládať prostredie Stateflow pod vedením našich lektorov

- Organizuje Humusoft
- Prezenčnou aj online formou
- V češtine, slovenčine, angličtine

- Ponúkame tiež **privátne školenia** na Vami vybrané témy

- Viacej informácií na **webe**:

https://www.humusoft.cz/training/

Ďakujem za pozornosť.

Otázky?