# Flowpack OBs

This exercise is meant to solve a production line problem using synchronous OBs (flowpack OB). This example is related to a machine preparing dumplings packages, where each box contains 3 dumplings.

## 1. Machine structure

In this exercise we don't focus on the complete flowpack machine, but just on the feeding system that prepares the product: one chain is bringing dumplings (chain), while another brings dishes (chain2). A structure scheme is shown in **figure 1**, as follows:

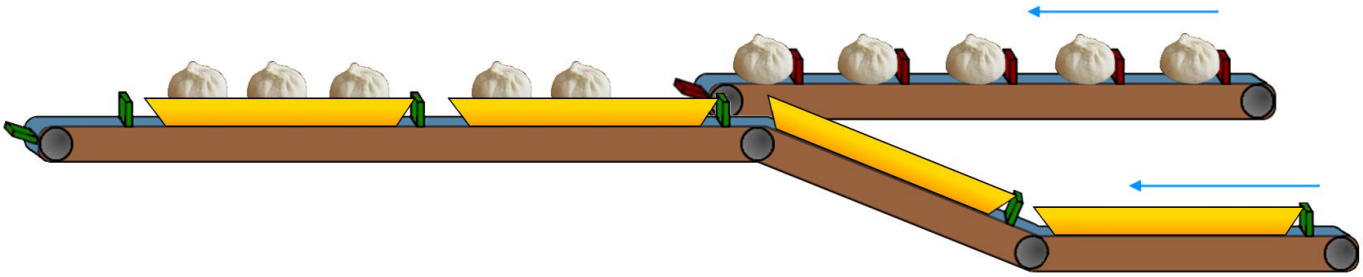

**figure 1** - Machine scheme

Since every dish contains 3 dumplings, it's easy to understand that together with synchronization of these two chains, a cycle modulation is necessary: each cycle of chain2 must correspond to 3 cycles of dumplings chain. Your target is to search among Robox flowpack OB library if there is an OB able to help you in this case, otherwise solve this situation on your own.

### 1.1 Dumplings Chain (Chain)

The dumplings rod chain is an axis bringing products which moves without any cam, just at linear speed. Each cycle is 150 mm long and fast stop time is 0.25 s. Oher parameters are listed as follows:

| | Speed [cycle/s] | Acc [cycle/s$^2$] | Jerk [cycle/s$^3$] |
|---|---|---|---|
| Jog | 0,5 | 5 | 25 |
| Reach master | 0,2 | 6 | 30 |
| Master lock | 3 | 6 | 30 |

### 1.2 Dishes Chain (Chain2)

This axis has a phase relative to the other chain of 120 degrees, and its cycle is 400 mm long. This axis makes a complete cycle when the other chain makes 3 ones, in order to feed each dish with 3 dumplings. All its kinematics parameters are the same as the other chain.

### 1.3 Function NPNB (No Product No Bag)

Customer request is never to create dishes with less than 3 products; therefore, a sensor is mounted 900 mm before the end of dumplings chain, in order to detect incoming products and check if any empty one is arriving, as shown in **figure 2**. If so, a function NPNB must be engaged: this permits to slow down and stop the dish chain and wait the dumplings chain to push until a new good product arrives in the dish, in order always to fulfill the 3 products per dish request. Look at **figure 3**, where chain2 makes a complete cycle among 4 dumplings chain's cycles, instead of 3, as normally happens.

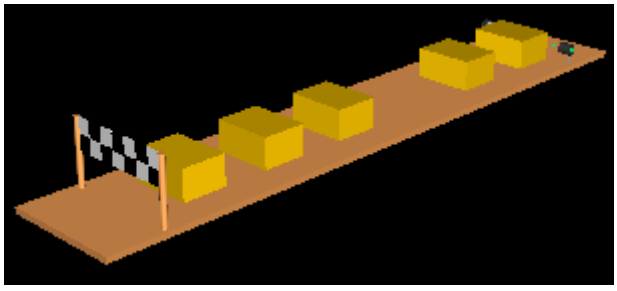

**Figure 2 –** Empty product incoming

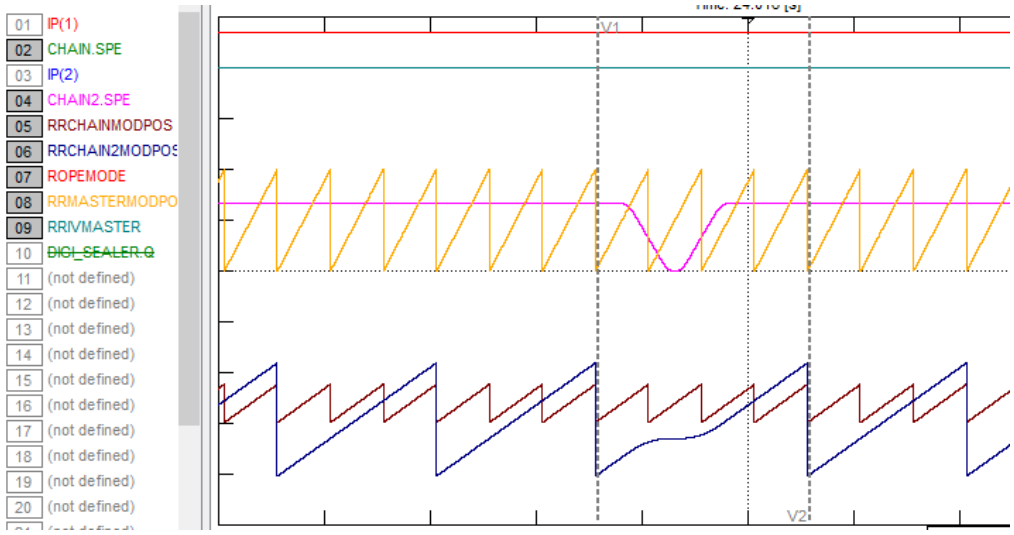


**Figure 3** – Oscilloscope of NPNB function to recover the empty cycle

You can see attached video to better understand this situation (*chapter 5*).

Your target is to search among Robox flowpack OB library if there is an OB able to help you in this case, otherwise solve the problem on your own. Provided data are listed below:

- Overturn phase = 0.2 cycle ; phase at which there is no more rod pushing (product falls from the dumplings chain into the dish)
- Brake/start_jerk = 0.5 ; [0 - 1 coefficient]
- Brake/start space = 0.5 ; [0 - 1 coefficient]
- Stop_offset = 0.3 cycle
- Sensor detection_window start = 0.4 cycle
- Sensor detection_window end = 0.9 cycle

## 2. Create a new project to control 2 axes

Create a new RDE project.
Create 2 axes and a power set to handle them.
Write task and rule to control the system. RP1 or RP2 controllers should be used.
Program this synchronous machine using Robox library Flowpack OBs.

## 3. Write rule and task file in R3 language to control the machine

Prepare to handle these operative modes:

- Power off
- Fast stop
- Idle
- Zero cycle
- Manual
- Posit
- Auto

Remember that task is used to make FSM and switch among operative modes (SELECT command), together with OB parameters update. Rules are used to control the motion.

Zero cycle is omitted in this sample, just set zero done to emulated axes.

Rule posit is to be used to move axis in the correct place before starting AUTO. This is done thanks to “reach_master” OB mode. Each time start button is pressed, system must check all axes positions and move them to avoid position steps or jumps.
If stop button is pressed during automatic, the machine must perform a phase stop at 90 deg of master cycle. Standard machine speed is 60 ppm (products per minute): this unit is

set by customer who wants to write speed parameter in that way, which is easy to understand production rate. It's up to you to convert it to related machine values. Machine speed can be modified runtime at any value from 30 ppm up to 90 ppm. Oher parameters are listed below:

| | Speed | Acc [cycle/s$^2$] | Jerk [cycle/s$^3$] |
|---|---|---|---|
| Jog | 0,4 [cycle/s] | 3 | 15 |
| Move (auto) | 30 – 90 [ppm] | 0,5 | 2,5 |

## 4. Debug

Switch on the system and make it work. On RDE make a control panel as shown in **figure 4**, with related control buttons to be able to handle all machine behaviors.

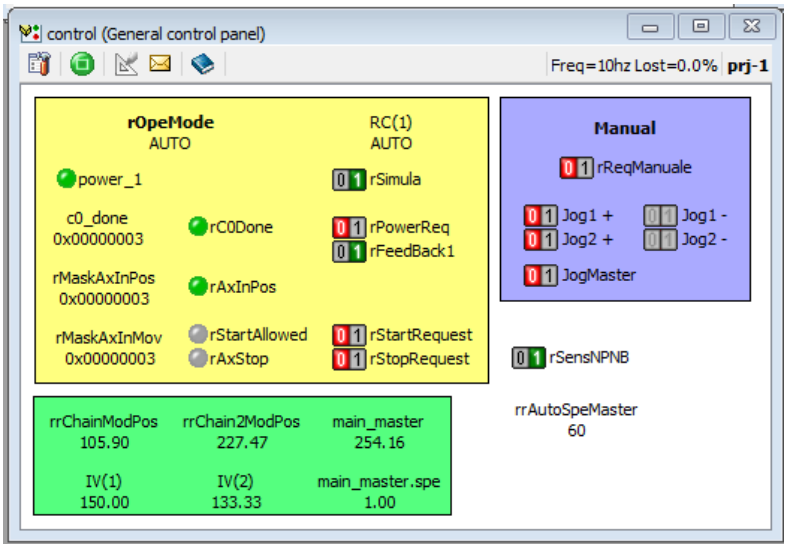


**Figure 4** – Example of control panel

An oscilloscope to show all axes' modulated positions and IV is required.
A 3D panel to see moving axes (**figure 5**) should be made as exercise.

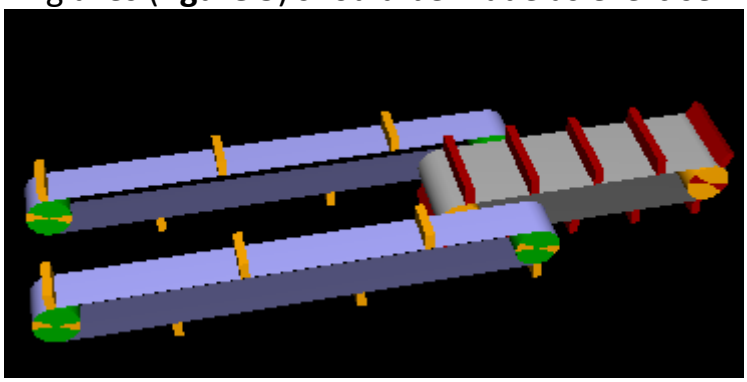

**Figure 5** – 3D panel to see moving axes

## 5. Video

You can see attached video to well understand the system and how it must work: during production you can see some empty slots in dumplings' chain. When they arrive at the overturn phase (the point where they fall into the dish), the dishes' chain performs a NPNB function, stopping and restarting in order to wait for a good product coming. Of course, if more than one slot is empty, the NPNB function will wait more cycles.
After a phase_stop and restart, no products are incoming on the dumplings' chain, so chain2 keeps waiting and makes its little movement only when a dumpling is getting in.
After the full production starts, chain2 can reach its master_lock speed and work normally.