

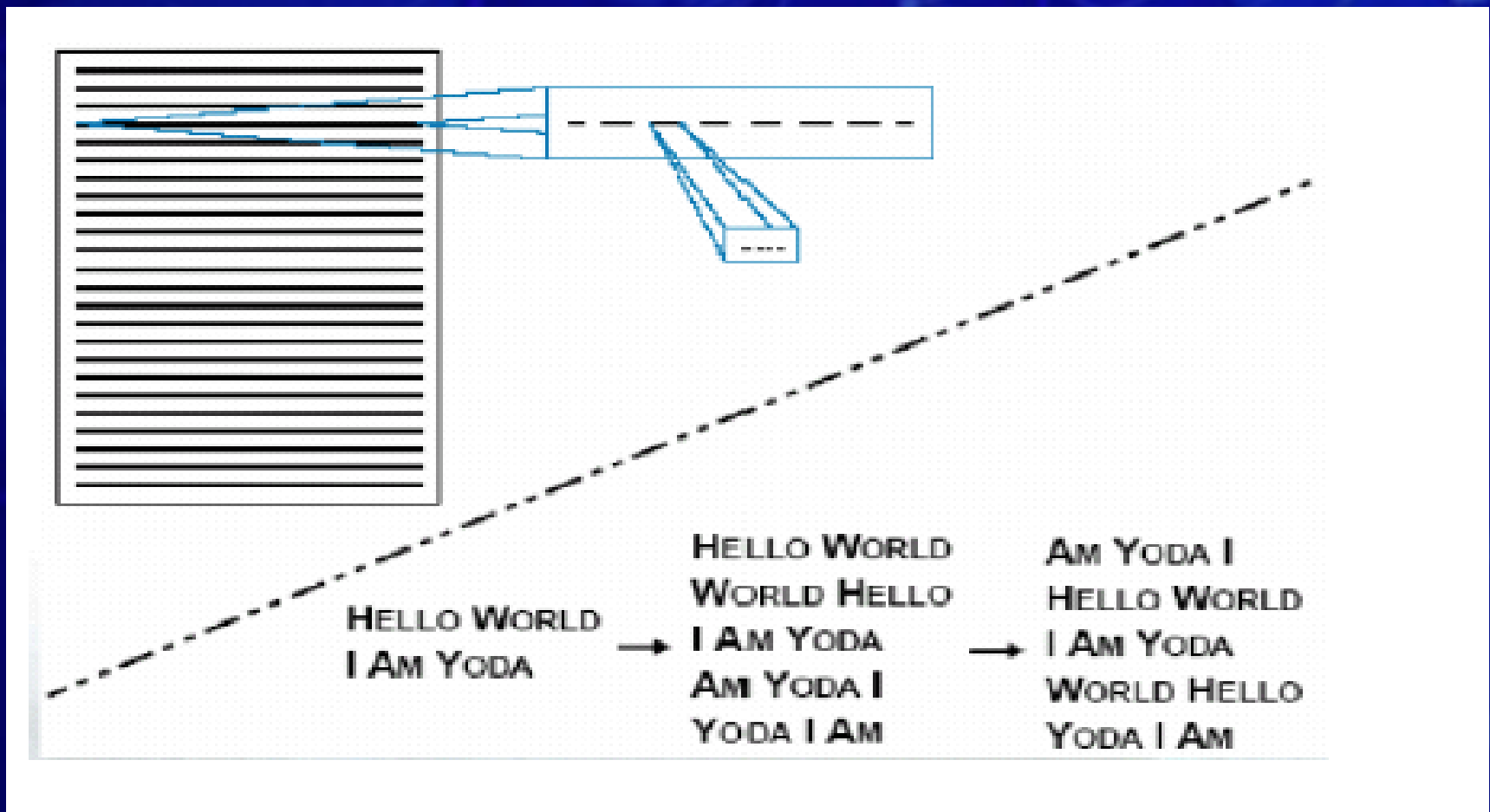
第4章 数据流风格——案例分析

➤ 本章主要内容

- ❑ 案例1: Key Words in Context
- ❑ 案例2. Instrumentation Software (仪器软件)
- ❑ 案例3. Cruise Control (巡航控制)——控制流

案例1——Key Word In Context

➤ 问题：Parnas proposed the following problem[1972]:



问题描述

- “The KWIC index system accepts an ordered set of lines, each line is an ordered set of words, and each word is an ordered set of characters. KWIC索引系统接受一些行，每行有若干字，每个字由若干字符组成
- Any line may be ‘circularly shifted’ by repeatedly removing the first word and appending it at the end of the line. 每行都可以循环移位。重复地把第一个字删除，然后接到行末
- The KWIC index system outputs a listing of all circular shifts of all lines in alphabetical order.”
KWIC索引系统输出按首字母排序输入所有行的列表

问题举例说明 (1/2)

- Input: Americans like driving cars fast on weekend days
- Shift lines circularly (单词循环移动) :
 - ❑ Americans like driving cars fast on weekend days
 - ❑ like driving cars fast on weekend days Americans
 - ❑ driving cars fast on weekend days Americans like
 - ❑ cars fast on weekend days Americans like driving
 - ❑ fast on weekend days Americans like driving cars
 - ❑ on weekend days Americans like driving cars fast
 - ❑ weekend days Americans like driving cars fast on
 - ❑ days Americans like driving cars fast on weekend

问题举例说明 (2/2)

- Alphabetize the lines (按字母顺序排列各行)
 - ❑ **Americans** like driving cars fast on weekend days
 - ❑ **cars** fast on weekend days Americans like driving
 - ❑ **days** Americans like driving cars fast on weekend
 - ❑ **driving** cars fast on weekend days Americans like
 - ❑ **fast** on weekend days Americans like driving cars
 - ❑ **like** driving cars fast on weekend days Americans
 - ❑ **on** weekend days Americans like driving cars fast
 - ❑ **weekend** days Americans like driving cars fast on

问题再举例说明 (1/2)

➤ 输入以下内容

- Architectures for software system
- Pipes and filters

➤ 单词循环移动后

- Architectures for software system
- for software system Architectures
- software system Architectures for
- system Architectures for software
- Pipes and filters
- and filters Pipes
- filters Pipes and

问题再举例说明 (2/2)

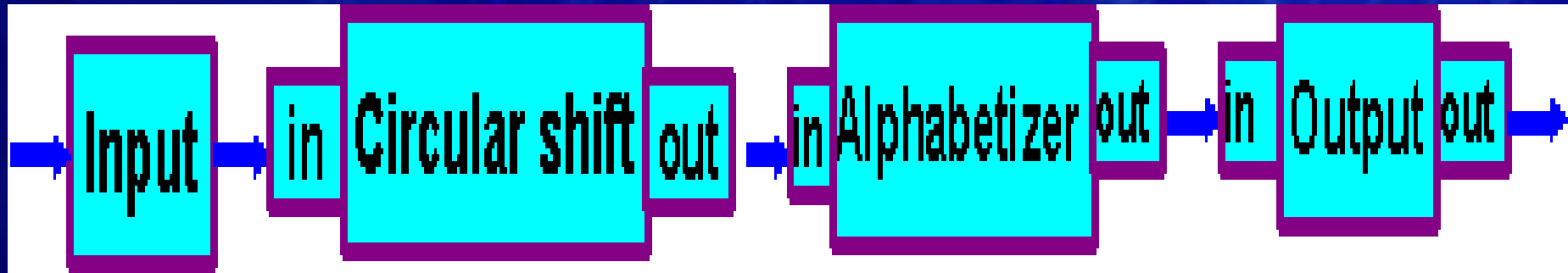
➤ 按字母顺序排列各行

- ❑ and filters Pipes
- ❑ Architectures for software system
- ❑ filters Pipes and
- ❑ for software system Architectures
- ❑ Pipes and filters
- ❑ software system Architectures for
- ❑ system Architectures for software

Pipe-and-filter 解决方案

- Basic structure: 四个过滤器
 - ❑ Input, shift, alphabetize, output
 - ❑ Each filter processes the data and sends it to the next filter.
- Control: The control is distributed.
 - ❑ Each filter can run whenever it has data on which to compute. 每个过滤器有数据就处理
 - ❑ Data sharing between filters is strictly limited to that transmitted on pipes 过滤器间的数据共享仅限于管道内传输的数据

Pipe-and-filte方案图



优点

➤ intuitive:

- ❑ It maintains the intuitive flow of processing.

➤ reuse:

- ❑ It supports reuse, since each filter can function in isolation

➤ Easy evolution:

- ❑ New functions are easily added to the system by inserting filters at the appropriate points in the processing sequence.新功能可通过增加过滤器很方便地加入

➤ Easy modification:

- ❑ it's easy to modify the system since filters are logically independent of other filters.过滤器间独立

缺点

➤ Poor Interaction: 交互能力弱

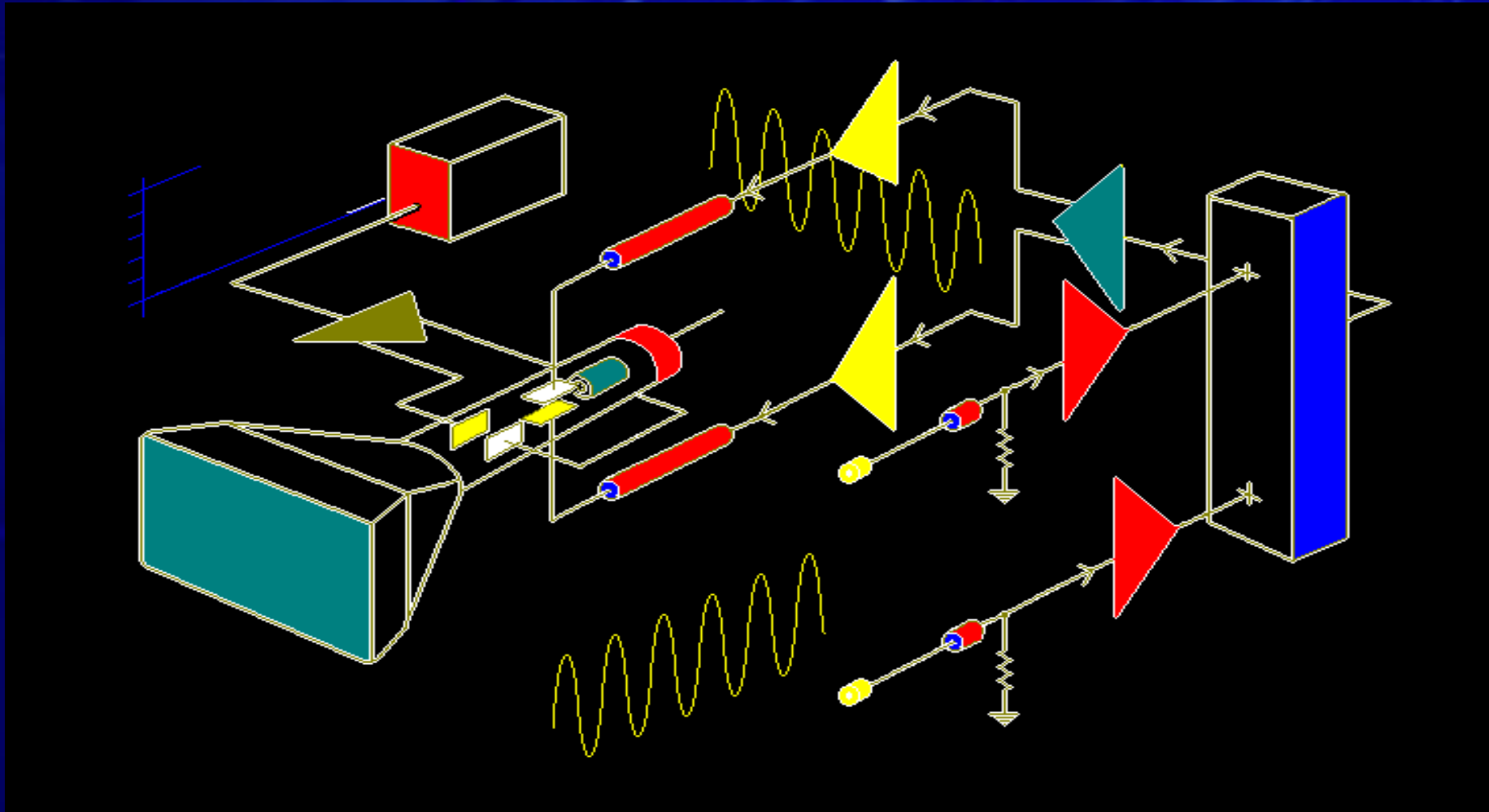
- ❑ It is virtually impossible to modify the design to support an interactive system. 不可能设计成交互系统
- ❑ For example, deleting a line would require some persistent (持久的) shared storage, violating basic principle of this approach. 如果需要删除一行, 则需要通过共享的持久存储实现, 而这不符合这种风格的要求。

➤ Waste of space:

- ❑ The solution uses space inefficiently, since each filter must copy all of the data to its output ports. 每个过滤器保存自己的一份数据

案例 2 —— 仪器软件

示波器工作原理图



示波器简介

- Objective: to show software design of An oscilloscope (示波器) in Tektronix, Inc to develop a reusable system architecture for oscilloscopes 为示波器设计一套可复用的系统架构
- 示波器采集电子信号，并将其转换成图形轨迹后显示到屏幕上
- 示波器也可用于信号的测量并显示结果

现代示波器的主要需求

➤ 现代示波器的主要需求包括：

- 提供MB级的内部存储空间
- 支持与工作站和其他设备的网络接口
- 提供高级用户接口
 - 触摸屏
 - 帮助
 - 彩显

项目目标

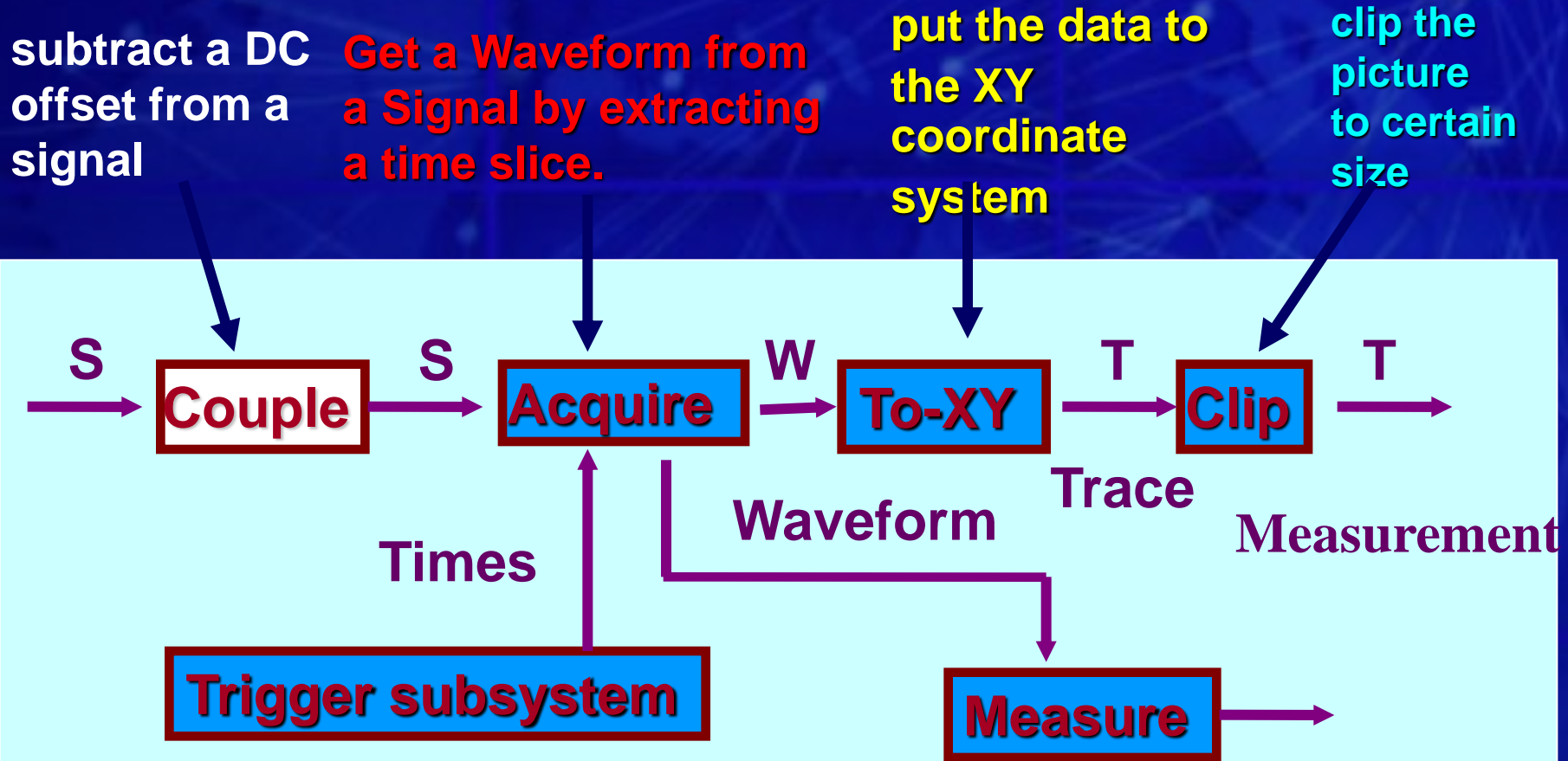
- Tektronix 总公司要写一个统一的示波器软件。
- The company needed to build a oscilloscope software.
- The reason is that the Corp. has many branches and each branch company wrote their own oscilloscope software.

公司有很多部门，每个部门写各自的示波器软件

问题

- little reuse across different oscilloscope products. 可重用性差
- different oscilloscopes were built by different product divisions
 - ❑ each with its own development conventions, software organization, programming language, and development tools. 不同示波器有不同的开发环境
- even within a single product division
 - ❑ each new oscilloscope typically had to be completely redesigned to accommodate changes in hardware capability and new requirements on the user interface. 硬件改变或用户界面需求变化

一种pipes-and-filters解决方案



优点

- It doesn't isolate the functions in separate partitions. 没有将功能割裂
 - E.g., nothing in this mode would prevent signal data from feeding directly into display filters.
- This model agrees with the engineers' view of signal processing as a dataflow problem
符合工程师从数据流角度分析的信号处理
- It has all the advantages that pipes-and-filters architecture should have
具备管道-过滤器的所有优点

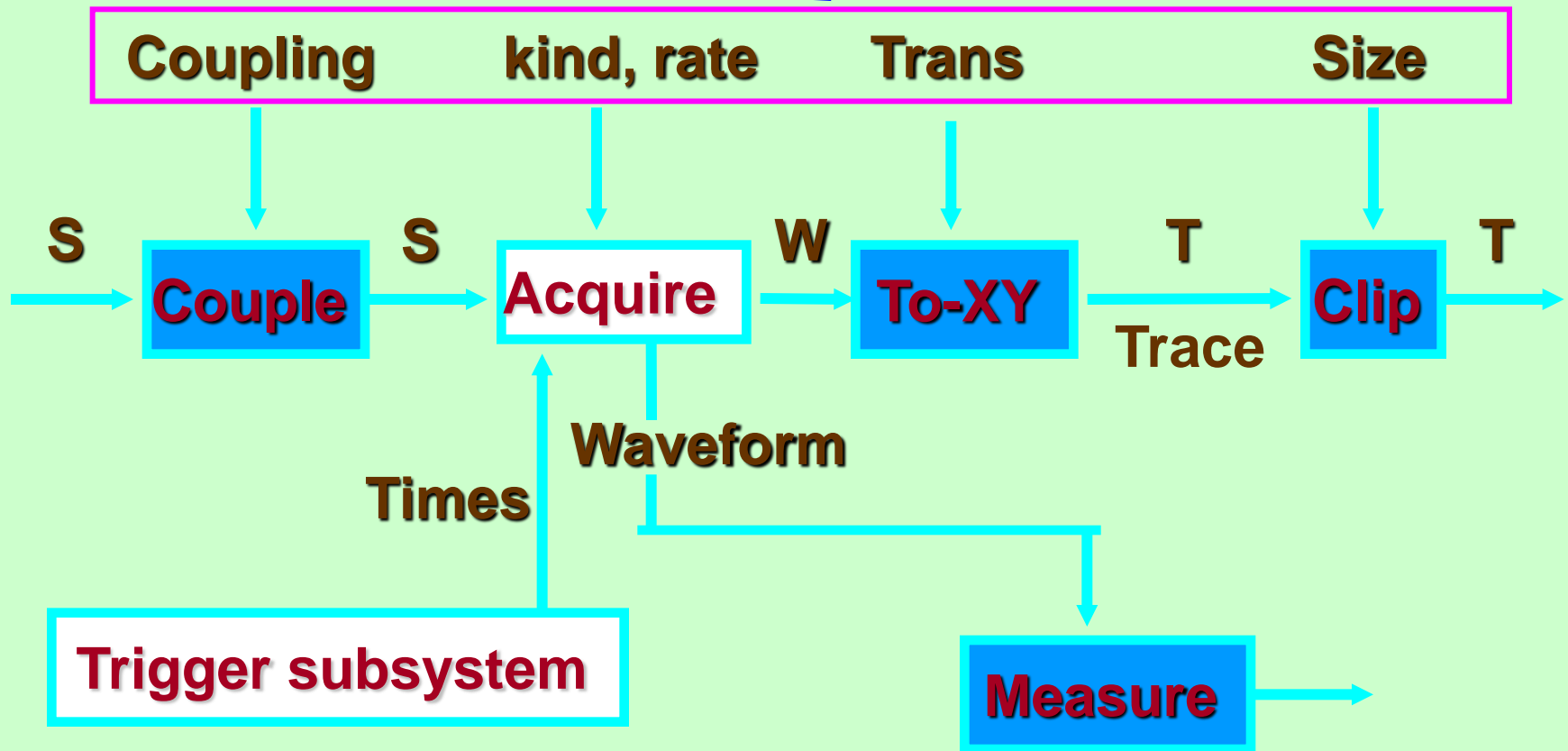
缺点

- The main problem with the model was that it was not clear how the user should interact with it. 没有约定用户如何与系统交互
 - ❑ Where the user interface should locate?
 - ❑ How the user will interact with it?
- Any better solutions?

一种参数化的pipes-and-filters解决方案

- introduce some parameters
- add user interface

Parameters



Component Couple

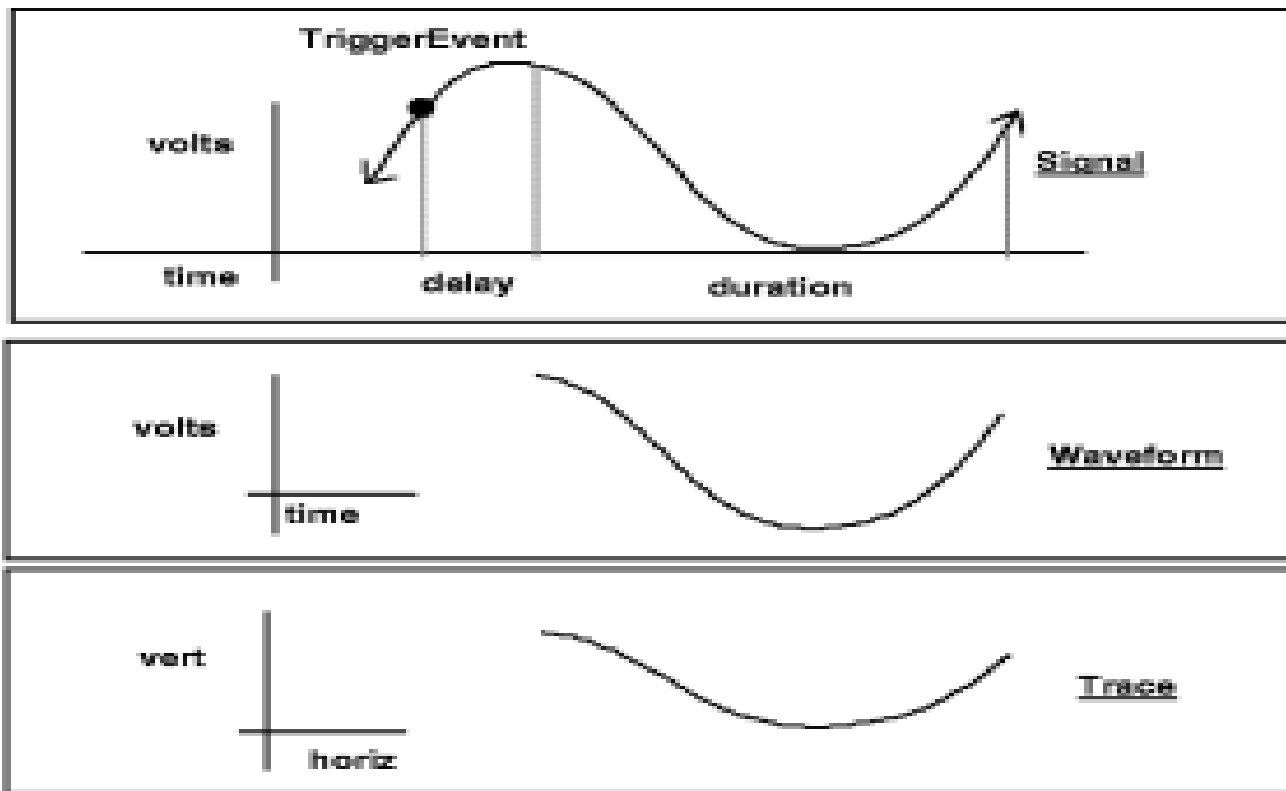
- Component Couple: This transformer is used to subtract a DC offset from a signal.
- In this case the user has three choices of parameterization: 耦合组件参数的三种选择
 - ❑ DC, if chosen, then the signal is unchanged
 - ❑ AC, if chosen, then the signal will be subtracted by an appropriate DC offset
 - ❑ Ground. if chosen, get a signal whose value is 0 volts at all times

Component Acquire

- Component Acquire 获取组件: through this, a Waveform is got from a Signal by extracting a time slice. 通过采样形成波形
- The waveform is identical to the signal, except that it is defined only over a bounded interval that determined by three things:
 - ❑ **time value delay**, determines when the interval is sampled relative to the reference time. 什么时候采
 - ❑ **time value duration**, determines the length of the interval 多长时间间隔采一次
 - ❑ **a reference time**, calls a trigger event. 调用触发事件

信号波形轨迹

Signals, Waveforms, Traces



其他组件

- Display transformers (To_XY and CLIP) convert these waveforms into visual data.
转换成可视数据
- To_XY: put the data got from the above step to the XY coordinate system
- CLIP (剪裁): clip the trace to certain size, or decide which part of the trace needs to be displayed on the screen.

方案说明 (1/2)

- This solution allows user inputs by associating with each filter a control interface that allowed an external entity to set parameters of operation for the filter.
 - ❑ For example, the acquisition filter could have parameters that determined sample rate and waveform duration.
- These inputs serve as configuration parameters for the oscilloscope.

方案说明 (2/2)

- One can think of such filters as having a "control panel" interface that determines what function will be performed across the conventional input/output dataflow interface Formally.
- The filters can be modeled as "higher-order" functions, for which the configuration parameters determine what data transformation the filter will perform.

方案的优点 (1/2)

- Dynamically modification: The parameterized pipes-and-filters architecture allows some aspects of the oscilloscope can be modified dynamically by the user.

可动态

- It also explains how the user can change oscilloscope functions by incremental adjustments to the software.

方案的优点 (2/2)

- Separation of the user interface: It separates the signal-processing functions of the oscilloscope from the user interface;
 - ❑ the signal-processing software makes no assumptions about how the user actually communicates changes to its control parameters.
 - ❑ Designers can therefore change the implementation of the signal-processing software and hardware without affecting the implementation of the user interface.

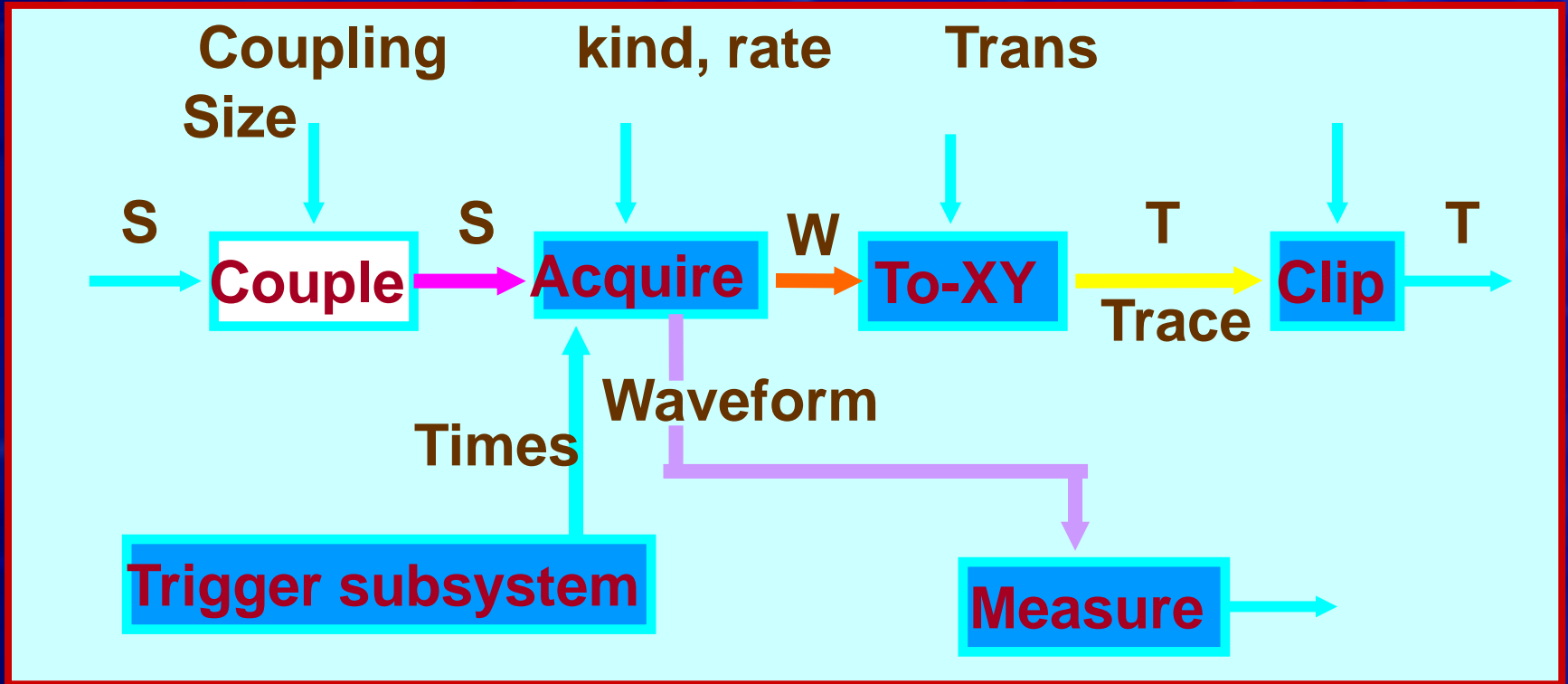
方案的缺点

- poor performance (性能差).
 - ❑ Large storage: waveforms can occupy a large amount of internal storage, it is simply not practical for each filter to copy waveforms every time they process them.
 - ❑ Different filter speed: Further, different filters may run at radically different speeds: it is unacceptable to slow one filter down because another filter is still processing its data.

多种管道类型的参数化Pipe-and-Filter方案

- To handle these problems the model was further specialized. Instead of using a single kind of pipe, we introduced several “colors” of pipes. 引入多种类型的管道
 - ❑ **No copying**: Some of these allowed data to be processed without copying.
 - ❑ **ignore incoming data**: Others permitted slow filters to ignore incoming data if they were in the middle of processing other data.
- These additional pipes increased the stylistic vocabulary and allowed the pipe/filter computations to be tailored more specifically to the performance needs of the product.

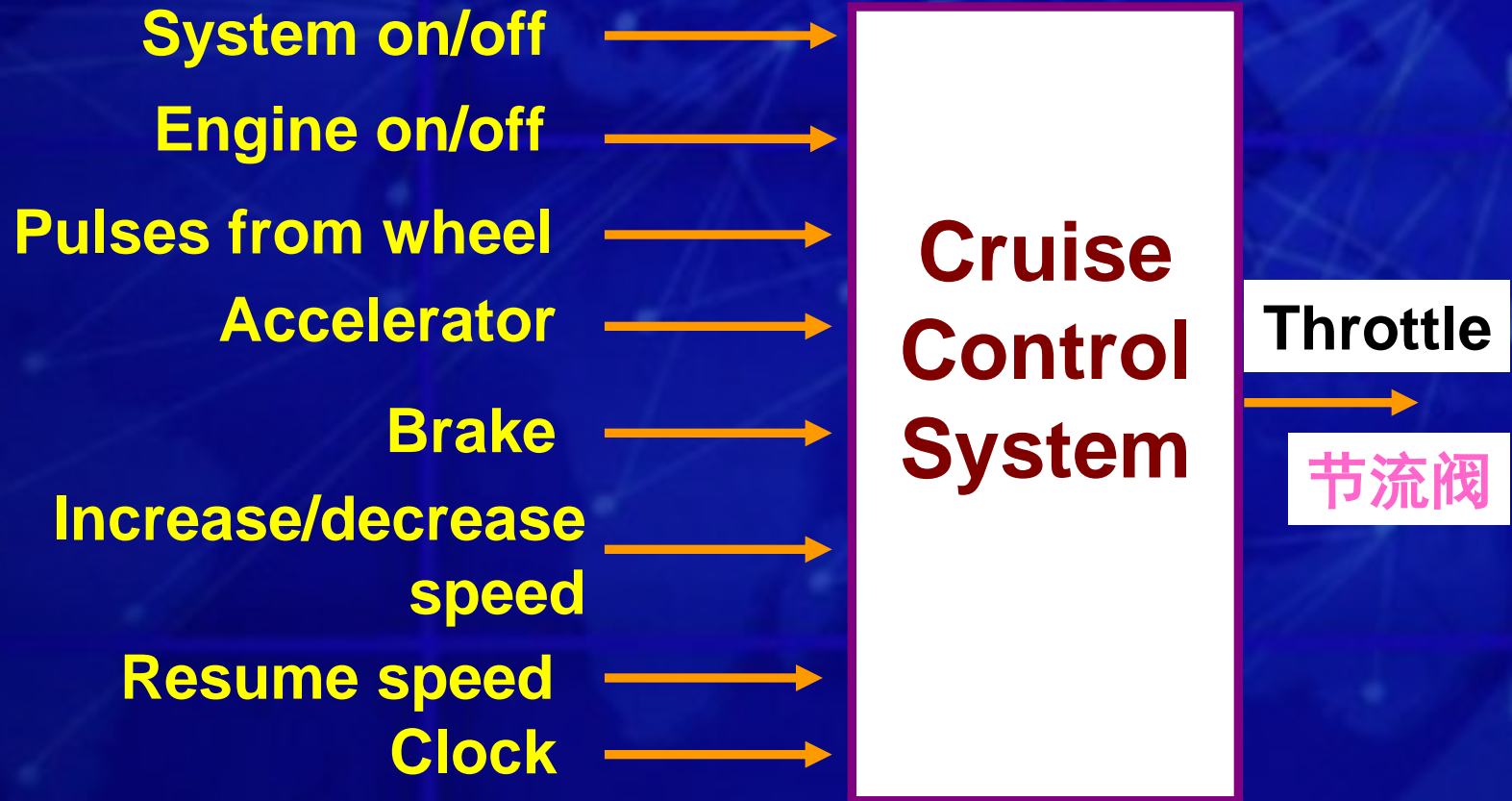
方案示意图



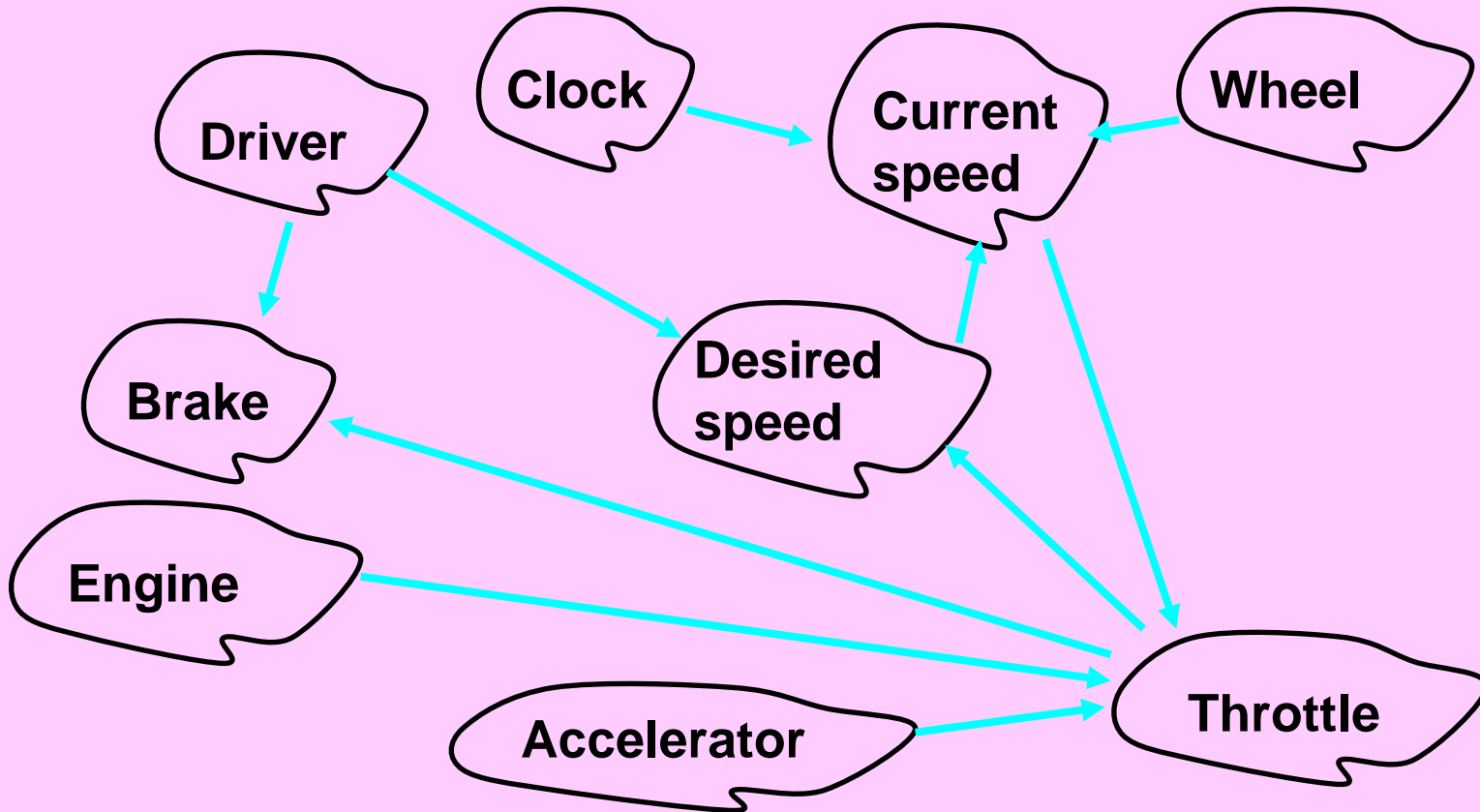
案例3 Cruise Control巡航控制

- What is a cruise control?
- A cruise-control system is used to maintain the speed of a car at any circumstances:
 - ❑ highway driving
 - ❑ upslope 上坡
 - ❑ downslope
 - ❑ varying terrain. 各种地形

Booch Block Diagram for Cruise Control



Booch's Object-Oriented Design for Cruise Control



输入项 (1/2)

- System on/off
 - ❑ If on, the cruise-control system should maintain the car speed.
- Engine on/off 发动机
 - ❑ If on, the car engine is turned on; the cruise-control system is only active if the engine is on.
- Pulses from wheel
 - ❑ A pulse is sent for every revolution of the wheel.
- Accelerator 油门
 - ❑ how far the accelerator has been pressed.
- Brake 刹车
 - ❑ On when the brake is pressed; the cruise-control system temporarily reverts to manual control if the brake is pressed.

输入项 (2/2)

- Increase/Decrease Speed
 - ❑ Increase or decrease the maintained speed; only applicable if the cruise-control system is on.
- Resume Speed
 - ❑ Resume the last maintained speed; only applicable if the cruise-control system is on.
- Clock
 - ❑ Timing pulse every millisecond
- Throttle 节流阀
 - ❑ output from the system, Digital value for the engine throttle setting

Computational elements (1/3)

- **Process definition: 通过控制节流阀控制速度**
 - ❑ the process takes a throttle setting as input and controls the speed of the vehicle.
- **Control algorithm: this algorithm**
 - ❑ gets the current speed from the wheel pulses,
 - ❑ compares it to the desired speed, and
 - ❑ changes the throttle setting.
 - ❑ The clock input is needed to determine current speed from the intervals between wheel pulses.
 - ❑ The policy decisions about how much to change the throttle setting for a given discrepancy between current speed and desired speed is localized in the control algorithm. 根据速度差

Computational elements (2/3)



➤ Data elements

- ❑ Controlled variable: the current speed of the vehicle.
- ❑ Manipulated variable: the throttle setting clock
- ❑ Set point: the desired speed is set and modified by
 - ❑ the accelerator input and
 - ❑ the increase/decrease speed input, respectively.

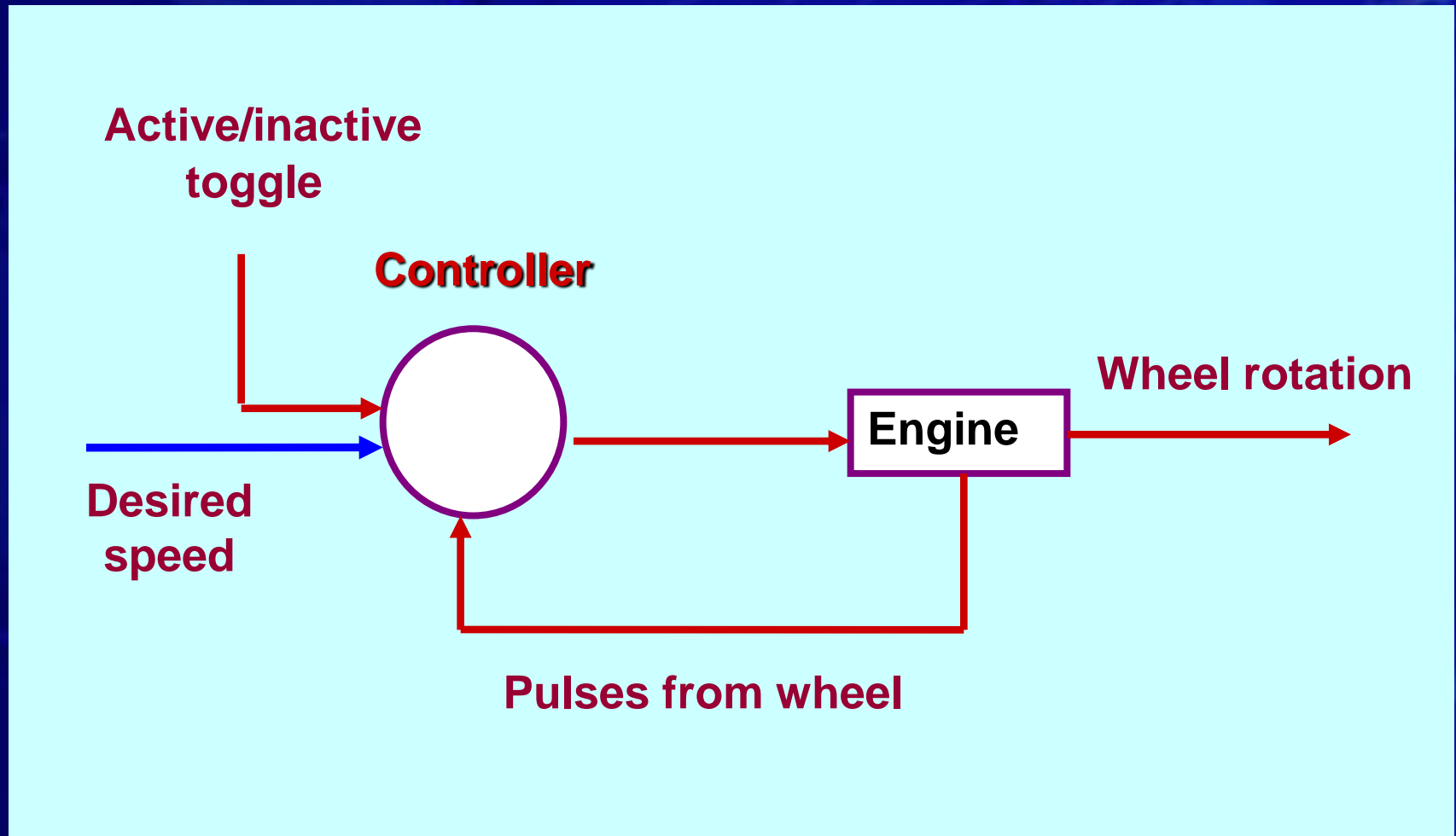
Computational elements (3/3)

- ❑ Several other inputs determine whether the cruise control is currently controlling the car: system on/off, engine on/off, brake, and resume (provided by the human driver (operator)).
resume restores automatic control, but only if the entire system is on.
- ❑ Sensor for controlled variable: For cruise control, the current state is the current speed, which is modeled on data from a sensor that delivers wheel pulses, using the clock.

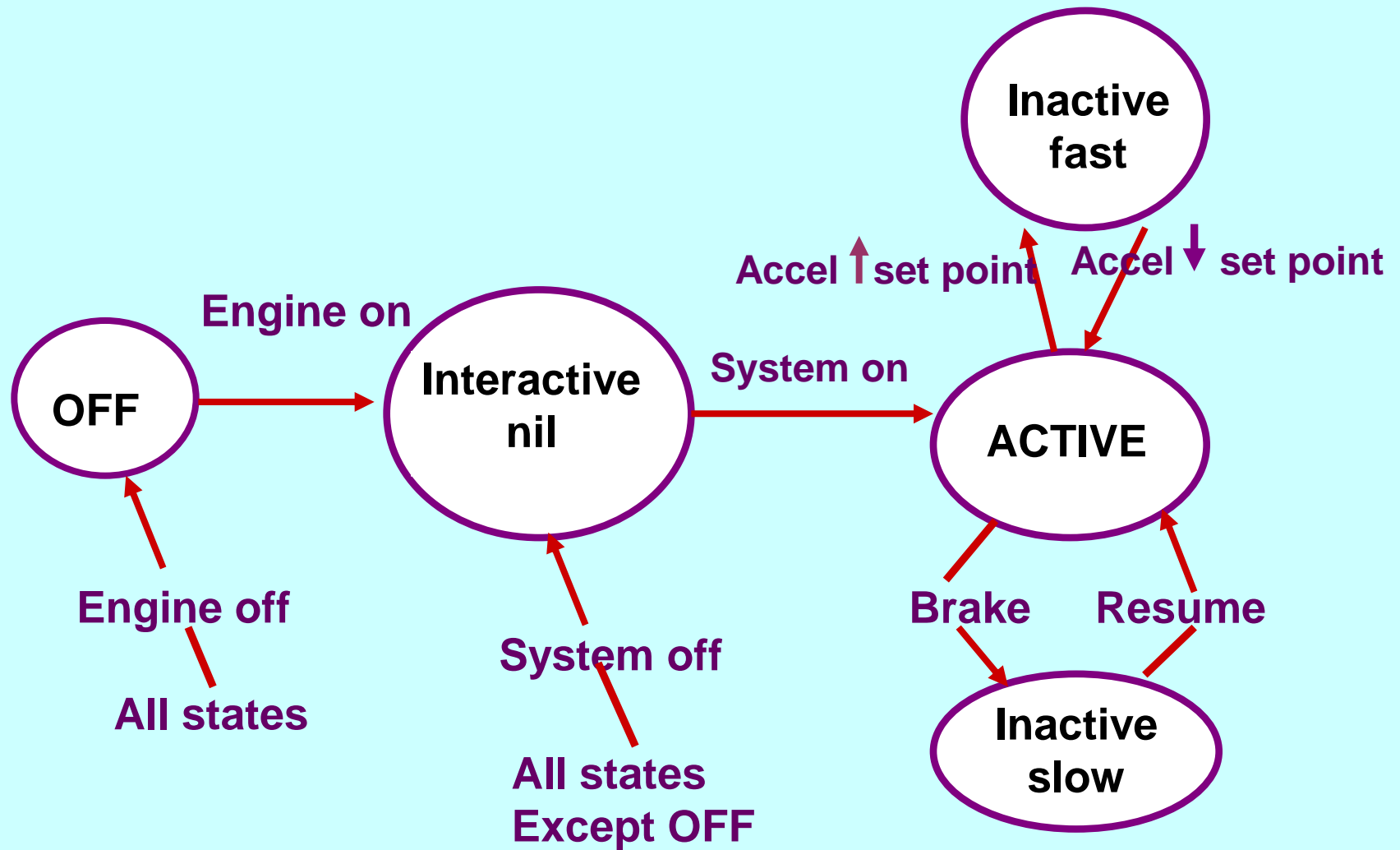
问题描述

- In the restated control task, note that only
 - ❑ the current speed output,
 - ❑ the wheel pulses input, and
 - ❑ the throttle manipulated variable
- are used outside the set point and active/inactive determination.

Control Architecture for Cruise Control



State Machine for Activation



Event Table for Determining Set Point

Event	Effect on desired speed
Engine off, system off	Set to "undefined."
System on	Set to current speed as estimated from wheel pulses.
Increase speed	Increment desired speed by constant.
Decrease speed	Decrement desired speed by constant.

Complete Cruise Control System

