

**Precision citrus production
concept based on
information from mobile
citrus fruit grading robot,
field-server, and satellite**

Ehime Agricultural Experiment Station

Yasushi KOHNO





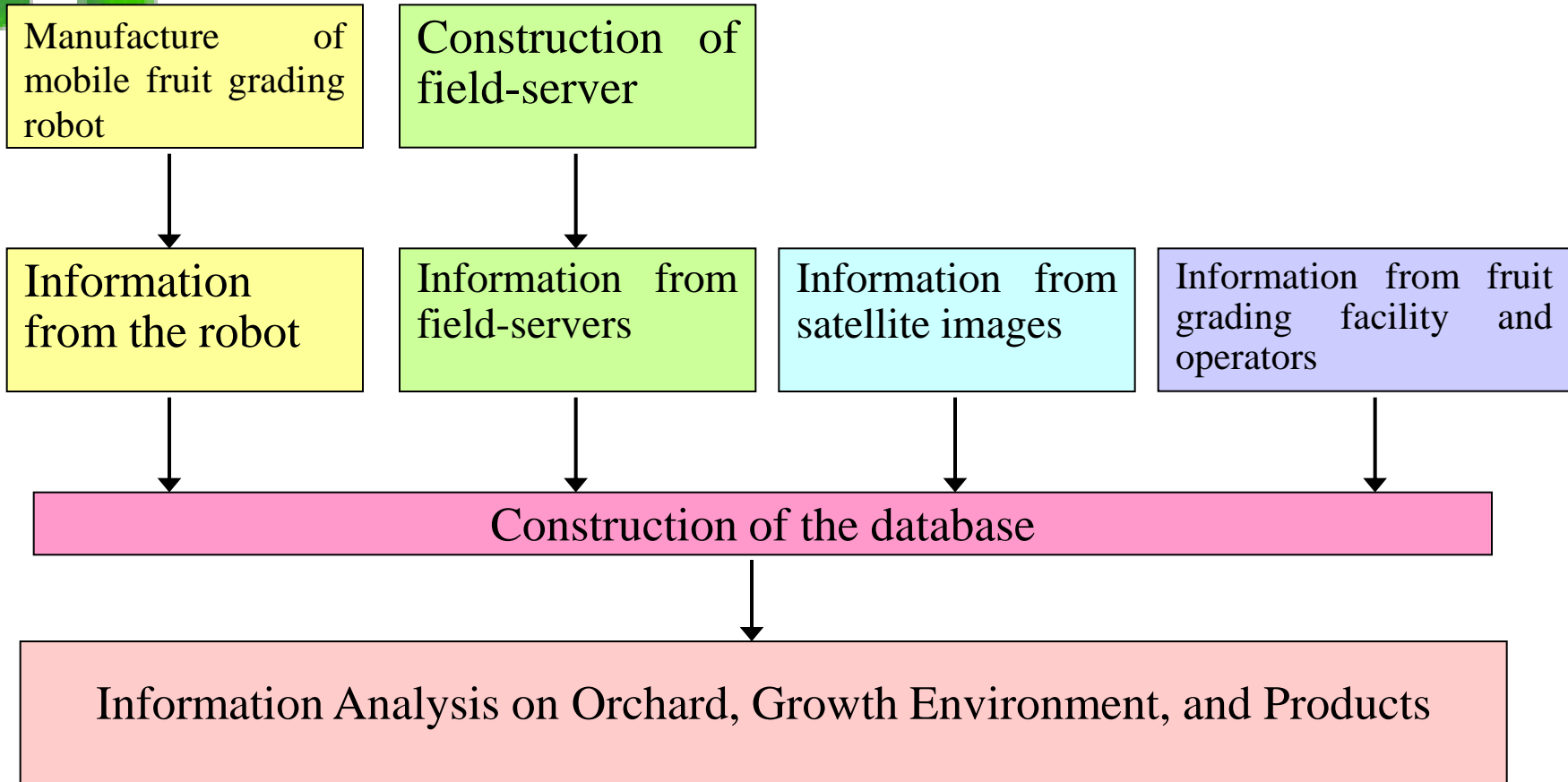
Terraced orchards of citrus fruit in West Japan



Mandarin oranges on the trees



Outline of the whole project





The aim of this study

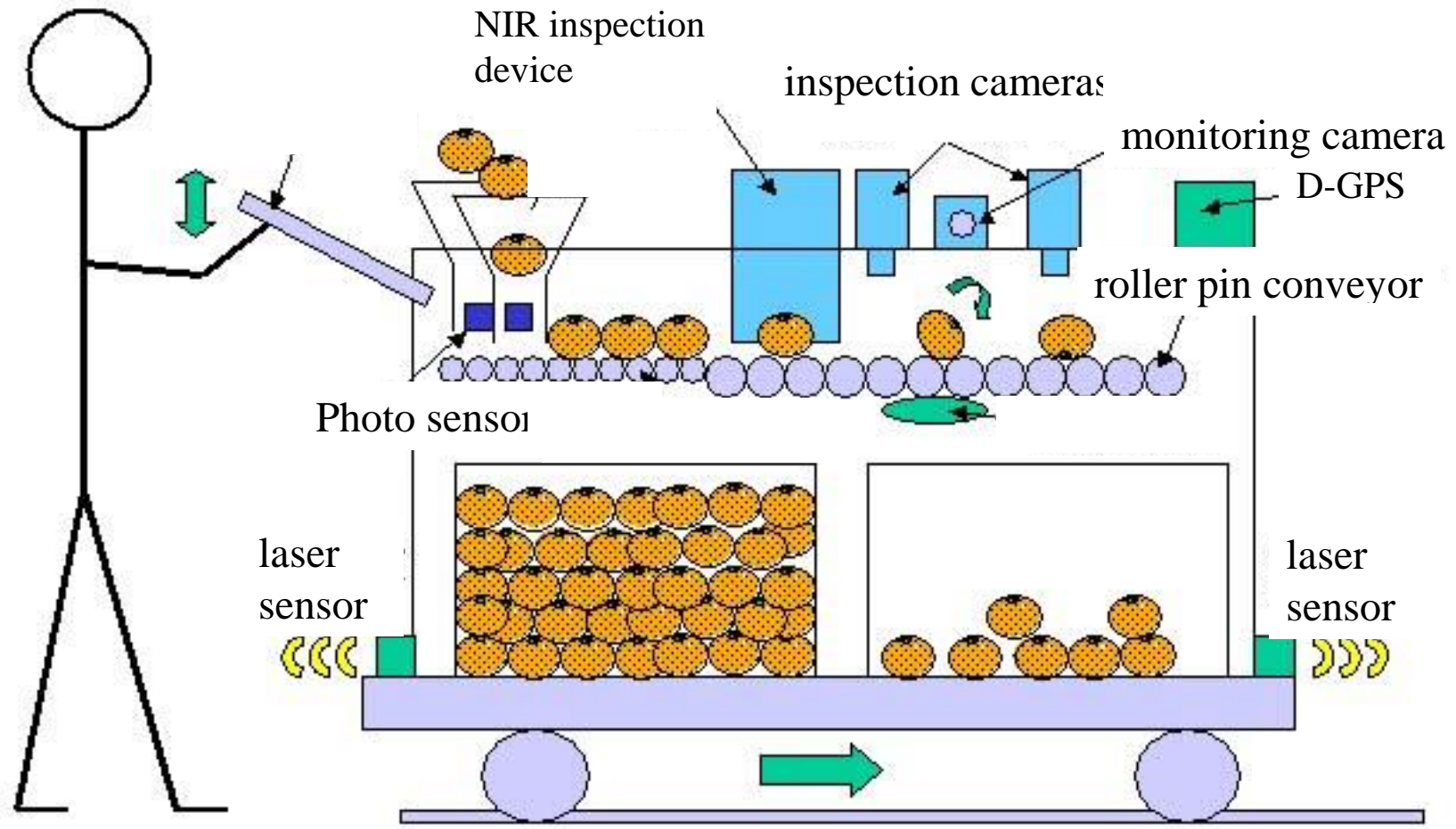
- ◆ To clarify performance and accuracy of each device by multi-dimensional analysis with spatial consideration and time scale.
- ◆ To clarify required information for precise production of citrus fruit and performance and function of each sensor.
- ◆ To enable the database to be used for both tree management and food traceability to keep safety and security on food distribution.

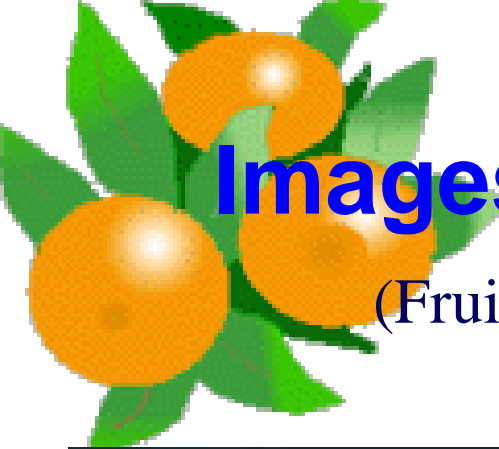




Information from Mobile citrus fruit grading robot

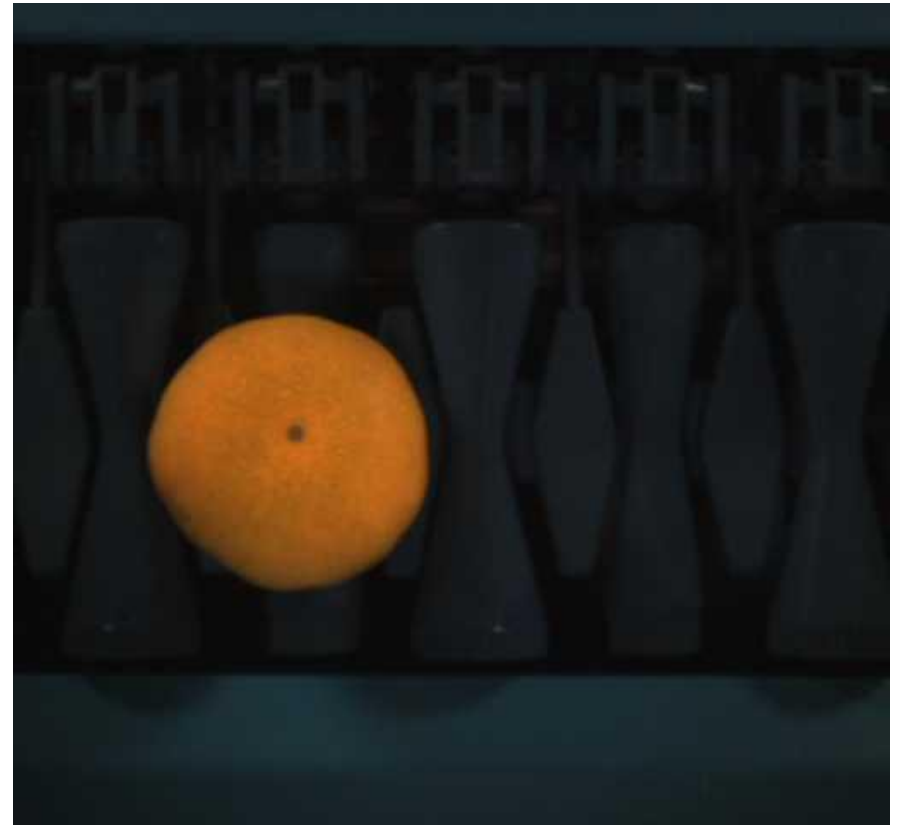
(Fruit location, harvesting time, Fruit appearance, Internal quality, Leaf color, Canopy size, Flower quantity etc.)

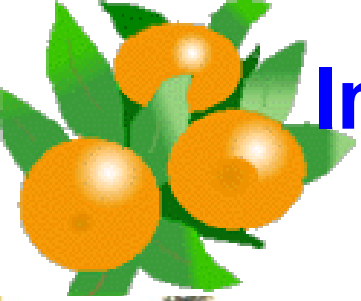




Images from inspection cameras

(Fruit appearance: color, shape, size, and defect)

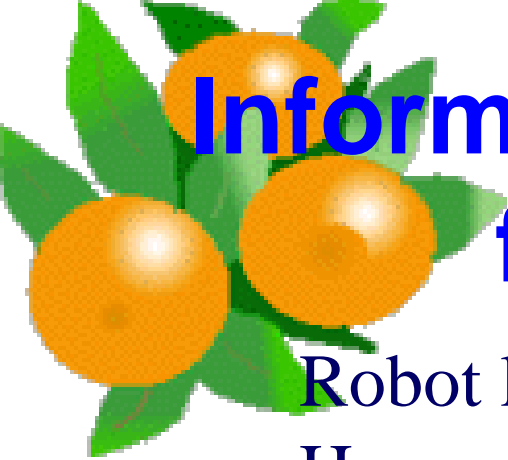




Images from monitoring camera

(Leaf color, Canopy size, Flower quantity)





Information from Mobile citrus fruit grading robot

Robot location

Harvesting Time

Fruit appearance: color, shape, size, and defect

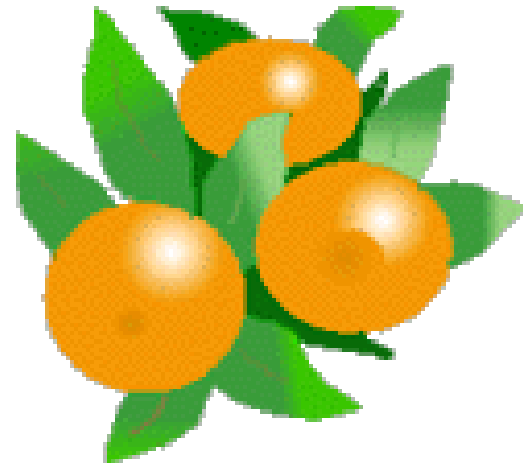
Internal quality : Sugar content

Canopy size (Field-server)

Flower quantity (Field-server)

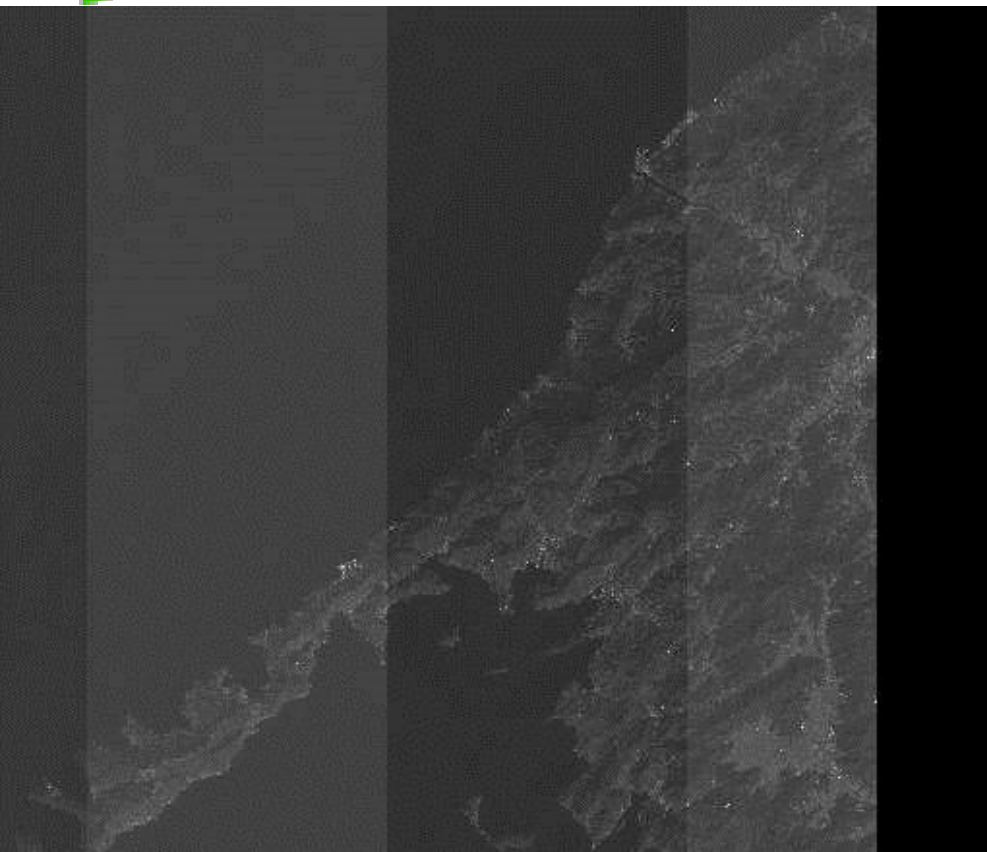
Leaf color (Satellite , Field-server)

etc.

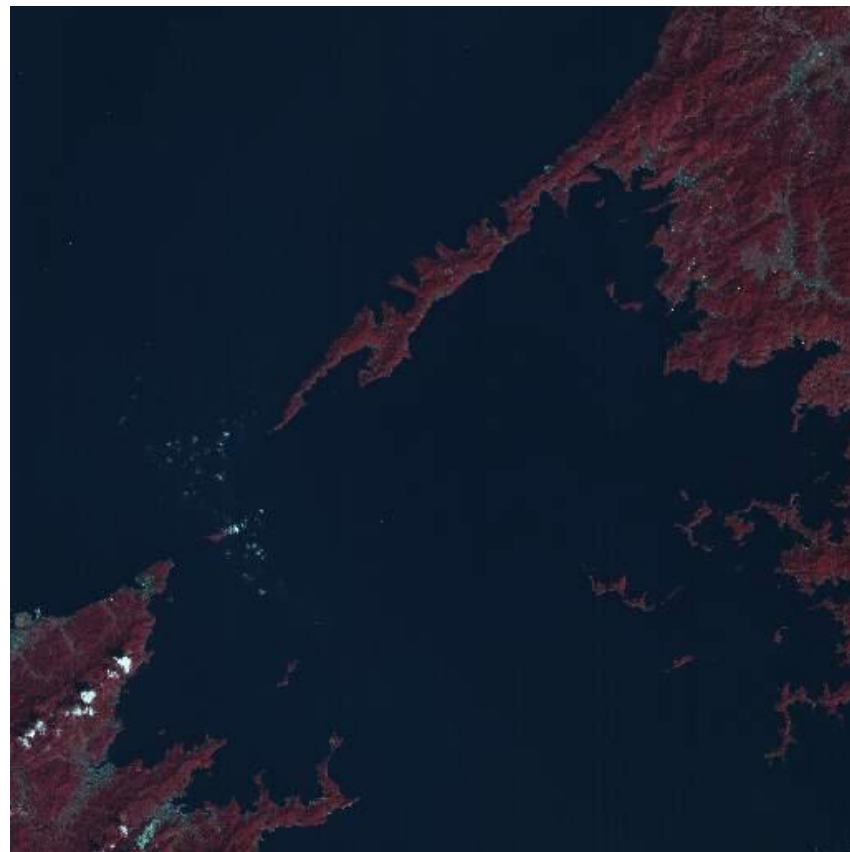


Satellite images of citrus production area (Ehime Prefecture, Shikoku, Japan)

Soil temperature, Water content of soil,
Leaf color

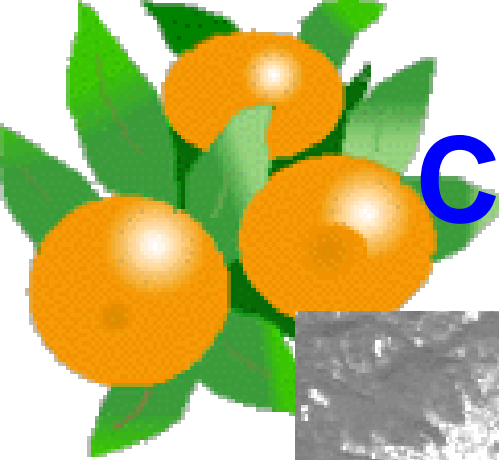


ALOS(PRISM: infrared image)

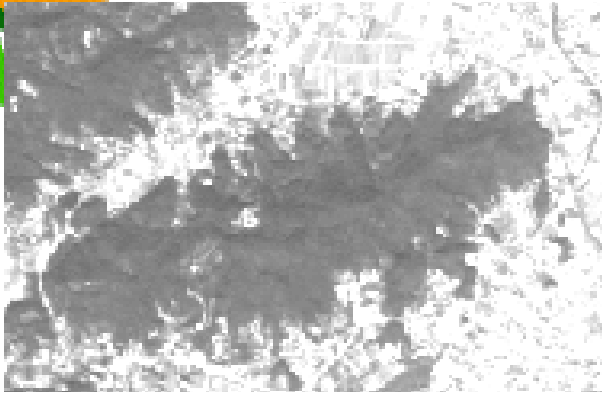


ALOS(AVNIR2:color image)

Courtesy of JAXA



Component images



Red image



Green image

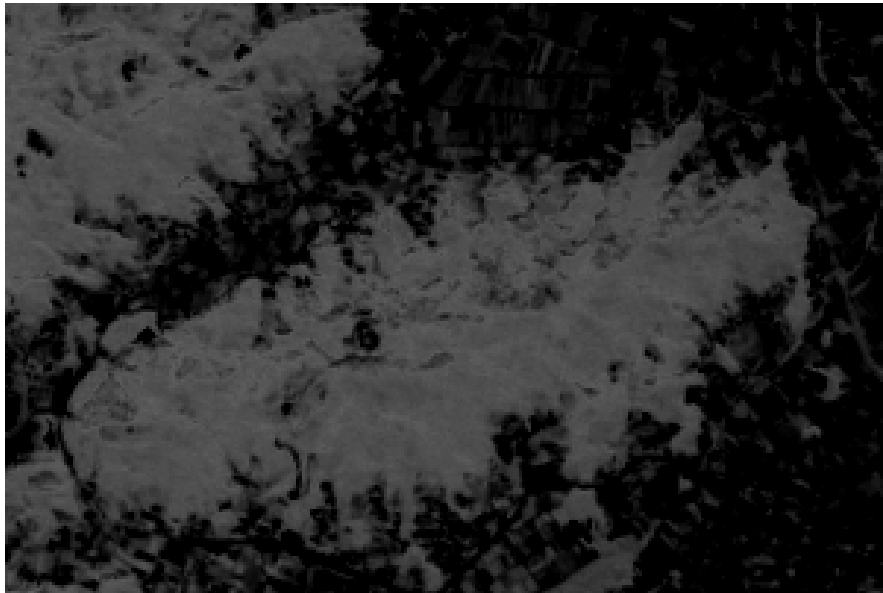
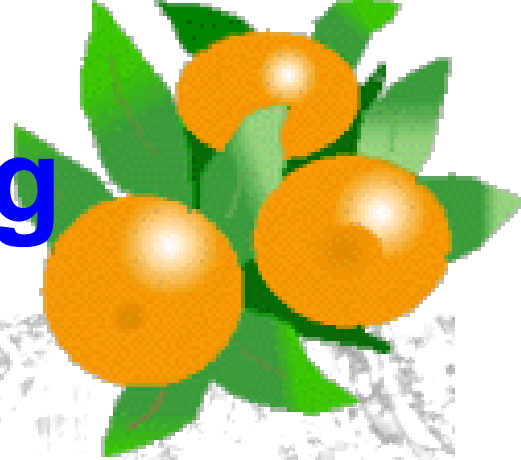


Blue image



Near Infrared image

Image processing

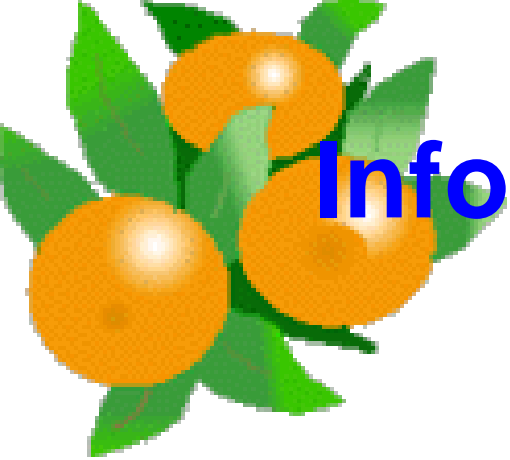


NDVI (Normalized Difference
Vegetation Index)

$$\frac{(\text{near infrared} - \text{red})}{(\text{near infrared} + \text{red})}$$

RVI (Ratio Vegetation Index)

$$\text{near infrared} / \text{red}$$

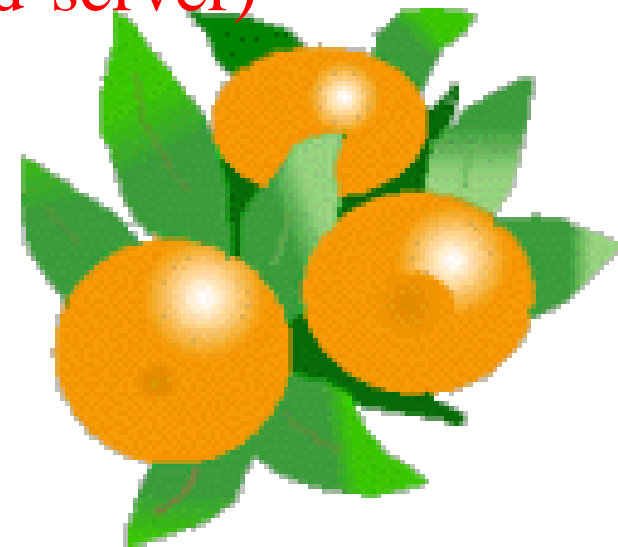


Information from Satellite

Soil temperature (Field-server)

Water content of soil (Field-server)

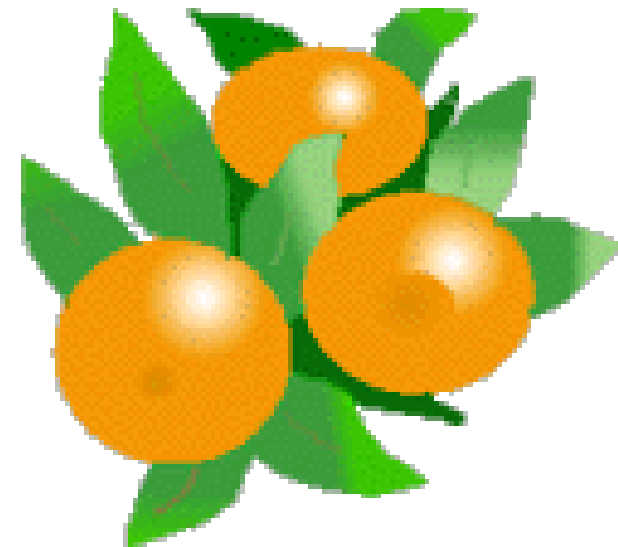
Leaf color (Grading robot, Field-server)





Information from Field-server

Temperature, Humidity Soil temperature, Soil water
Quantity of sunlight, Precipitation, Wind direction and velocity
Leaf color, Flower quantity, Canopy size





Information from Field-server

Temperature

Humidity

Soil temperature (Satellite)

Water content of soil (Satellite)

Quantity of sunlight

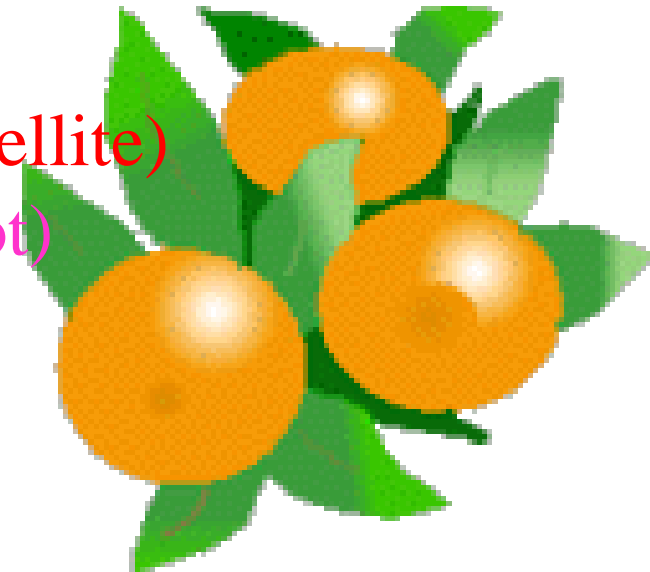
Precipitation

Wind direction and velocity

Leaf color (Grading robot, Satellite)

Flower quantity (Grading robot)

Canopy size (Grading robot)



Information from fruit grading facility and operators

Fruit appearance, Internal quality, Farm ID, Fertilization, Irrigation, Operation time and date

Fruit grading facility



Production history

生産資材適正使用安全管理システム プレミックス システム管理責任者様

ファイル 編集 表示 印刷 新規入力 ツール ヘルプ

OCR画像表示

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共通 平成 18 年度 JA000 薬剤防除実績

3 2 生産者 2 07 温州みかん(宮川早生) 10 21

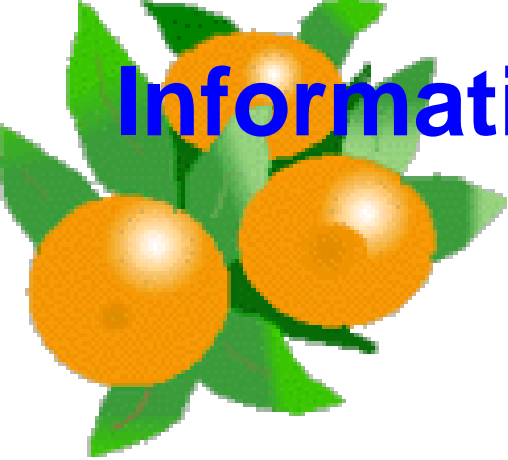
農薬防除実績表(農薬, 防草剤, ジベレリン, 落果防止剤, 挿挿剤)

農薬防除実績番号	農薬名	対象農作物	処理日	処理回数	処理量	処理単位	処理時間	処理場所	処理者
92822	マネージ水和剤		04	07		0	2000		50
93342	ストロピ-ドサイフロアブ		05	20		0	3000		130
90789	オルトラン水和剤		05	20		0	1500		50
92853	フロンサイドSC		05	27		0	2000		50
91412	ハーベストオイル		06	03	1200				50
93016	スズベラン水溶液		06	10	4000				25
90645	マイマイベレット	ナメシ	06	14					17

ページが表示されました

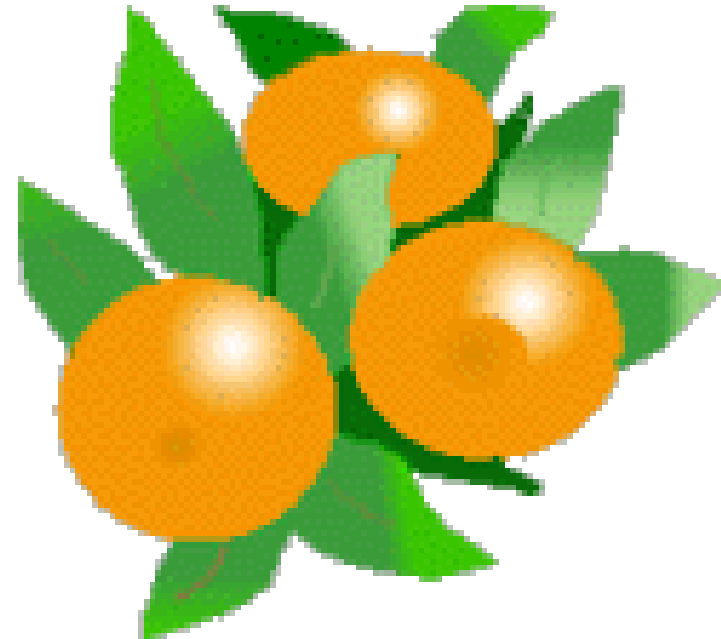


Information from fruit grading facility and operators



Fruit appearance : color, shape, size, and defect
Internal quality : Sugar content

Farm ID
Fertilization
Irrigation
Chemicals
Operation time and date



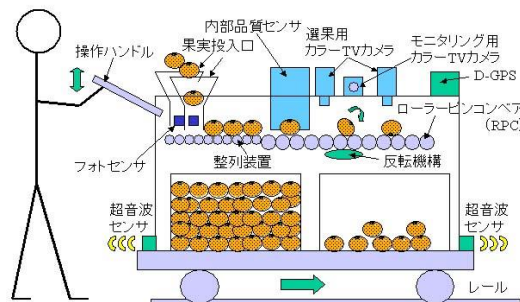
Satellite



JAXA

Wide-range geography
Environmental info.

Grading robot



Product info.

Field-server

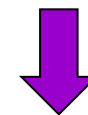
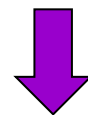
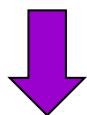
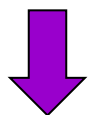


Local climate Info.
Environmental info.

Grading facility and Operator

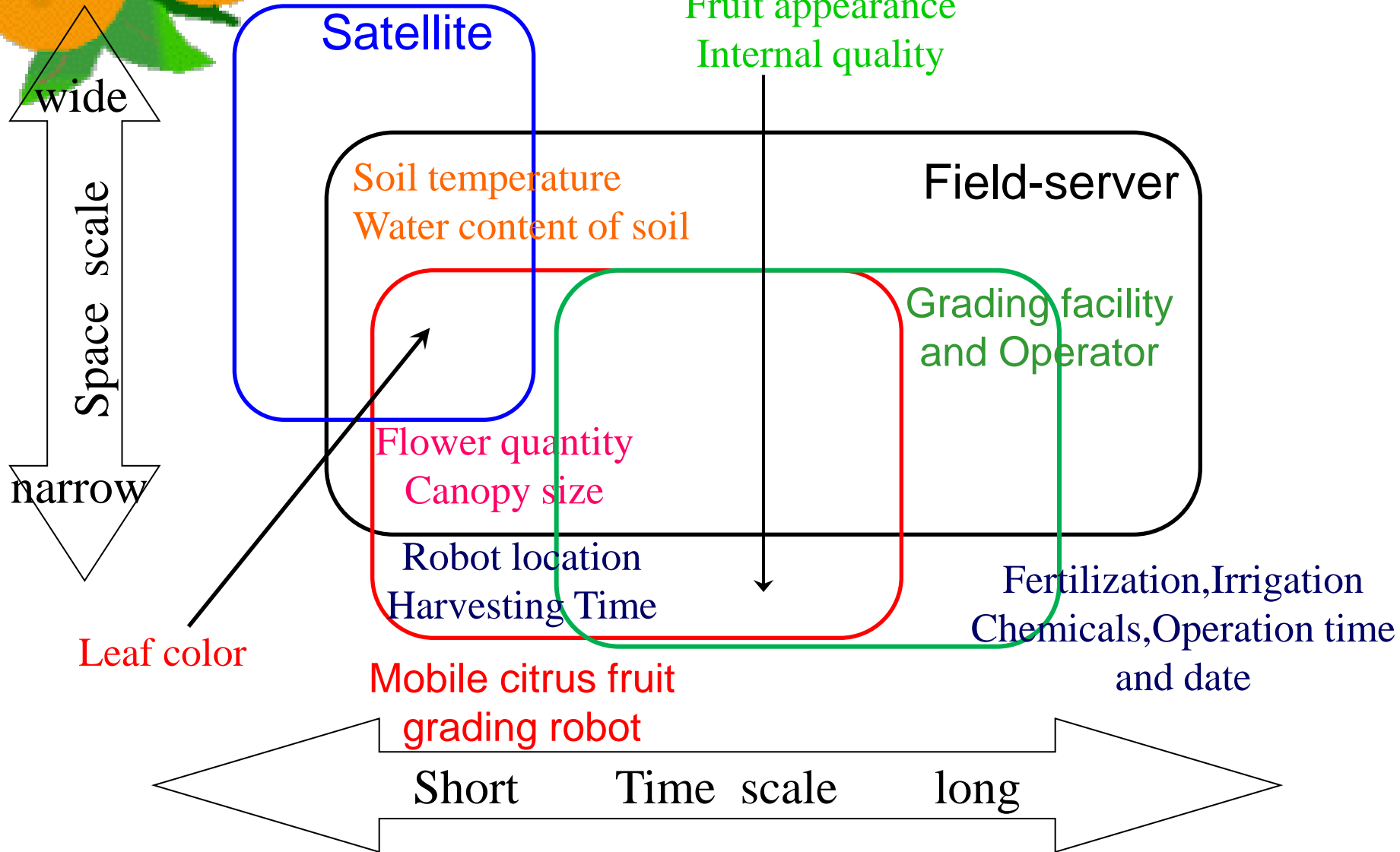
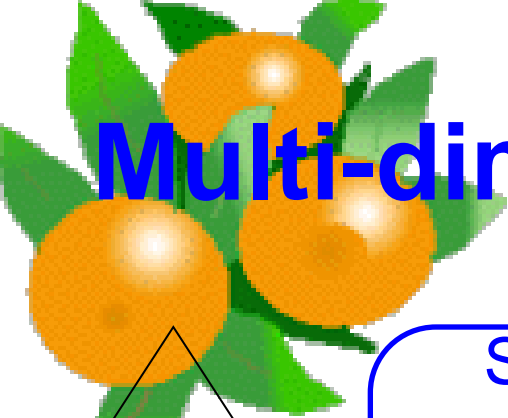


Operation record



Database

Multi-dimensional analysis of data



Analysis of relation between input and output data

Multiple classification analysis

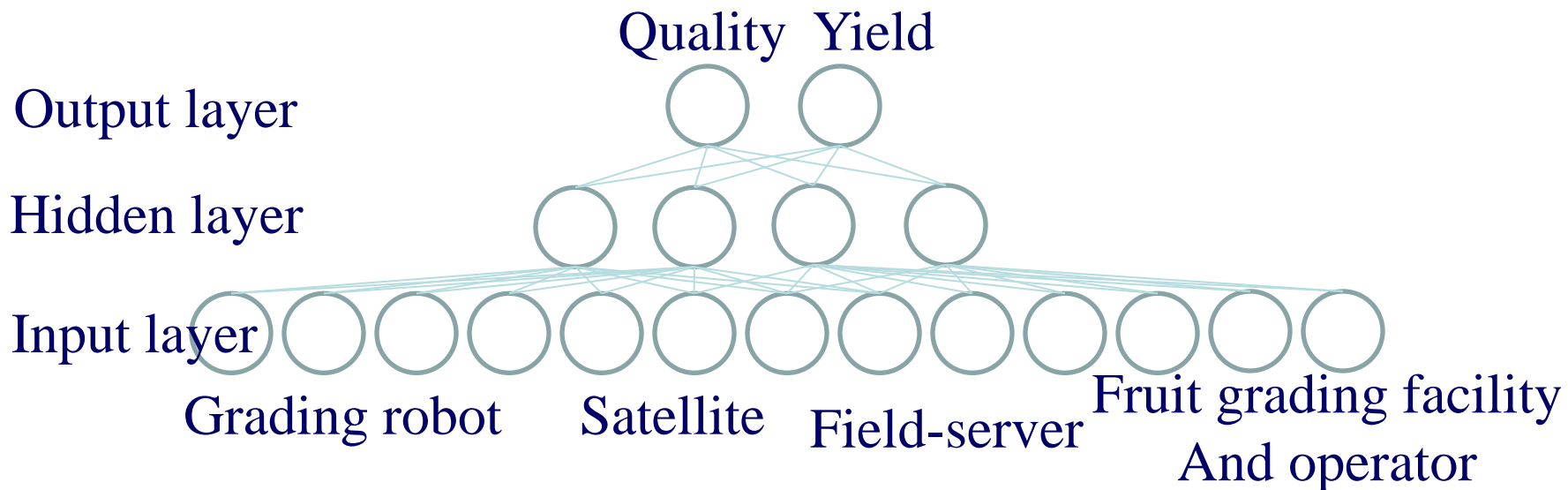
$$Y = a_0 + a_1 X_1 + a_2 X_2 + a_3 X_3 + \dots + a_n X_n$$

Response variable:
output (Quality, Yield)

Variable

Explanatory variable: Input

Neural network



Our goal

Establishment of Precision citrus production

(Minimum input creates highest quality and yield on citrus production.)

