

# Validation & Verification of GIS-Based Population Data Conversion Program (POPCON)

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# Introduction

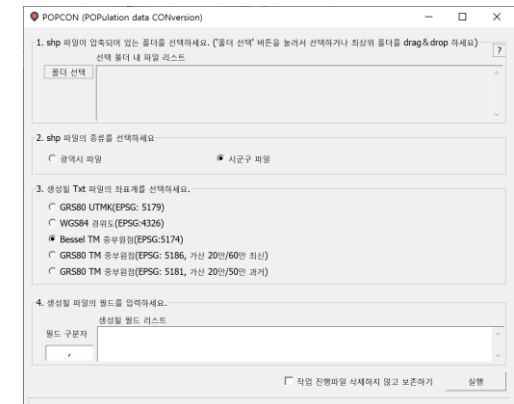
## ■ POPCON (POPulation data CONverter)

- GIS-based population data conversion program developed by Korea Atomic Energy Research Institute (KAERI).
- POPCON converts Shape-formatted population data (.shp) downloaded from National Geographic Information Institute (NGII)  
→ User-specified text format regarding coordinate system.

## ■ Validation and verification (V&V) are fundamental procedures to guarantee the quality of a developed S/W

## ■ Software testing conducted in this study

- Verification testing
- Application testing



User Interface of POPCON

# Verification Testing

- Execution procedures

- Receiving data (100m×100m population data of Seoul)
- Selecting a coordinate system to be converted
- Setting the order and separator of fields (columns) to be created

- Acceptance criteria of the verification testing  
(related with requirement specification)

1. Whether the user-specified field order and separator are applied to the result file
2. Whether the number of grids in input data matches the number of rows in output file
3. Whether the total population of input and output is identical
4. Whether the coordinate system of the result image overlays with background map

# Verification Testing: Acceptance Criterion 1

- User-specified field order and separator
  - Test by **changing** the **order of the columns** and **separator** (from comma to pipe)

```
_result.txt - Windows 메모장
파일(F) 편집(E) 서식(O) 보기(V) 도움말(H)
시군구|X|Y|총 인구 수(남자)|총 인구 수(여자)|20대 인구 수(남자)|20대 인구 수(여자)|20대 인구 수(전체)|30대 인구 수(전체)|40대 인구 수(전체)|50대 인구 수(전체)|60대 인구 수(전체)|70대 인구 수(전체)|80대 인구 수(전체)|90대 인구 수(전체)|100대 인구 수(전체)
성동구|200650.10|449110.26|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000
성동구|200649.57|449210.30|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000
성동구|200649.04|449310.34|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000
성동구|200752.79|448610.61|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000
성동구|200752.25|448710.64|30.000000|29.000000|0.000000|0.000000|7.000000|0.000000|0.000000|8.000000|7.000000|0.000000|0.000000|0.000000|0.000000
성동구|200751.72|448810.68|143.000000|141.000000|15.000000|12.000000|27.000000|18.000000|12.000000|30.000000|21.000000|0.000000|0.000000|0.000000|0.000000
성동구|200751.19|448910.72|245.000000|296.000000|28.000000|28.000000|56.000000|37.000000|41.000000|78.000000|66.000000|0.000000|0.000000|0.000000|0.000000
성동구|200750.66|449010.75|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000
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성동구|200749.60|449210.83|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000
성동구|200749.07|449310.87|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000
성동구|200748.54|449410.90|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000
성동구|200748.01|449510.94|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000
성동구|200853.35|448511.10|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000|0.000000
성동구|200852.82|448611.14|41.000000|53.000000|0.000000|0.000000|7.000000|0.000000|9.000000|10.000000|16.000000|14.000000|0.000000|0.000000|0.000000
성동구|200852.29|448711.17|116.000000|132.000000|18.000000|14.000000|32.000000|16.000000|18.000000|34.000000|30.000000|0.000000|0.000000|0.000000|0.000000
성동구|200851.76|448811.21|178.000000|208.000000|20.000000|13.000000|33.000000|44.000000|43.000000|87.000000|77.000000|0.000000|0.000000|0.000000|0.000000
성동구|200851.23|448911.25|236.000000|288.000000|36.000000|39.000000|75.000000|20.000000|33.000000|53.000000|53.000000|0.000000|0.000000|0.000000|0.000000
성동구|200850.70|449011.29|113.000000|153.000000|6.000000|18.000000|24.000000|15.000000|27.000000|38.000000|38.000000|0.000000|0.000000|0.000000|0.000000
<
Ln 37, Col 50      100%  Windows (CRLF)  ANSI
```

POPCON result by changing the order and separator of fields

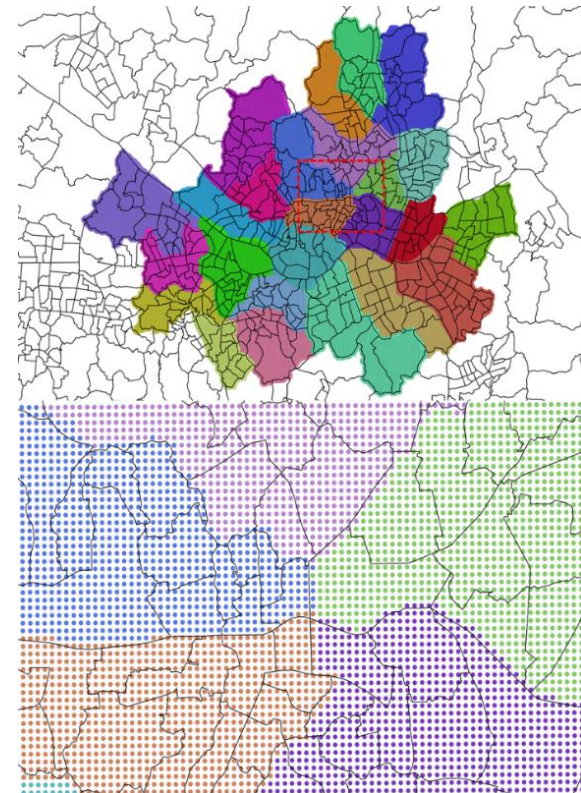
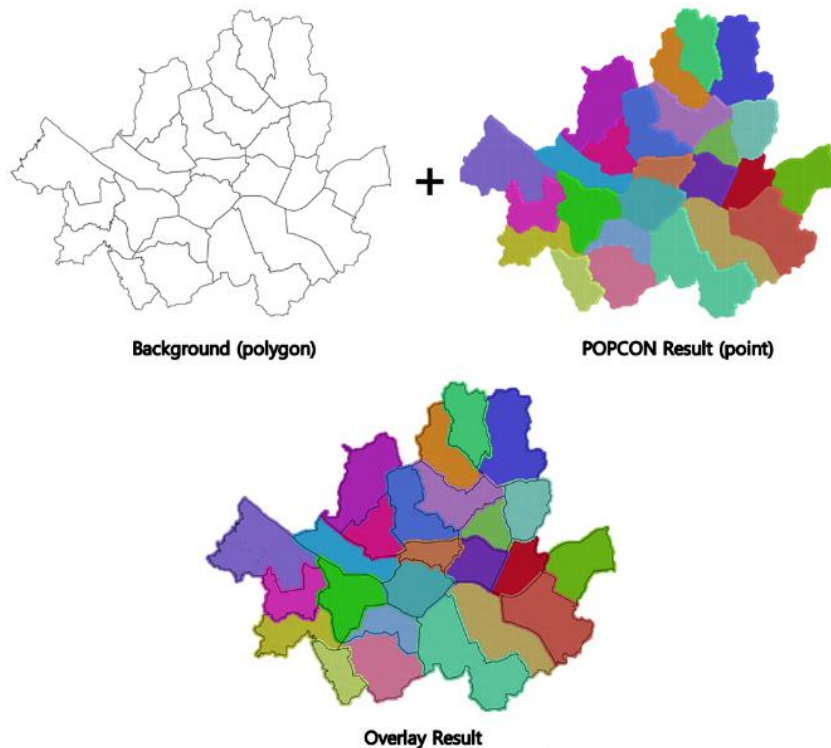
# Verification Testing: Acceptance Criterion 2 & 3

- The number of grids and total population in each district of input data and POPCON
  - The number of grids in input data = the number of rows in output file
  - Total population of input = Total population of output

Administrative district	No. of grids in input	No. of point locations in POPCON result	Total population of input	Sum of population In POPCON result
Gangnam	4,170	4,170	543,593	543,593
Gangdong	2,596	2,596	434,448	434,448
Gangbuk	2,528	2,528	312,526	312,526
Gangseo	4,382	4,382	588,345	588,345
Gwanak	3,130	3,130	498,720	498,720
Gwangjin	1,812	1,812	349,688	349,688
Guro	2,211	2,211	403,609	403,609
Geuncheon	1,424	1,424	232,044	232,044
Nowon	3,743	3,743	530,225	530,225
Dobong	2,226	2,226	330,764	330,764
Dongdaemun	1,539	1,539	344,337	344,337
Dongjak	1,773	1,773	393,606	393,606
Mapo	2,570	2,570	371,536	371,536
Serdaemun	1,916	1,916	305,871	305,871
Seocho	4,963	4,963	428,455	428,455
Seongdong	1,794	1,794	297,969	297,969
Sungbuk	2,654	2,654	441,085	441,085
Songpa	3,578	3,578	672,661	672,661
Yangcheon	1,926	1,926	453,811	453,811
Yeongdeungpo	2,605	2,605	362,077	362,077
Yongsan	2,325	2,325	228,402	228,402
Eunpyeong	3,170	3,170	476,634	476,634
Jongro	2,563	2,563	150,662	150,662
Jung	1,107	1,107	125,435	125,435
Jungrang	1,972	1,972	394,952	394,952
Total	64,677	64,677	9,671,455	9,671,455

# Verification Testing: Acceptance Criterion 4

- Coordinate system of the result image overlays with background map



Example of overlay testing:  
Background map overlapping of  
Bessel TM central origin (EPSG: 5174)

Method of overlay testing to a background map  
in order to verify the compatibility of POPCON  
with various coordinate systems

# Application Testing

## ■ Application testing

- Interfacing test between POPCON and KOSCA-POP

1. Testing with population data of different resolutions:  
500m, 250m, and 100m

2. Testing whether the output of the sectors with no resident population is calculated correctly

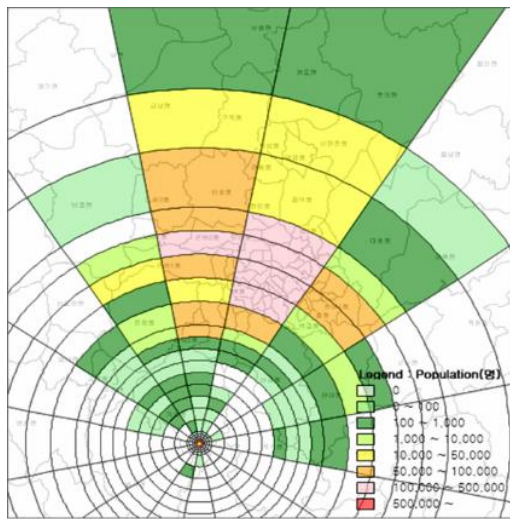
– Two kinds of population data were used:

- 1) Daejeon, where KAERI is located, to check the mountainous and lake area
- 2) Busan close to the sea

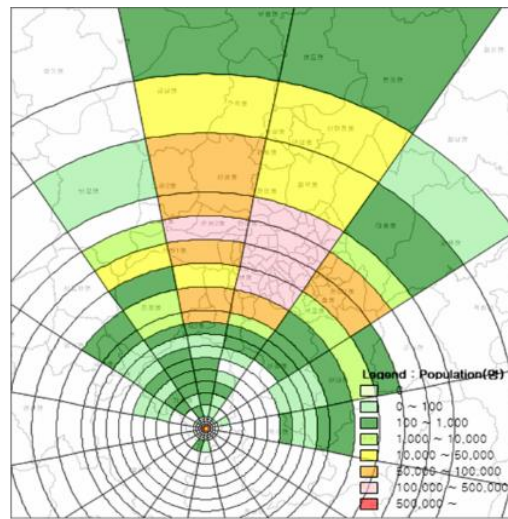


# Application Testing: Pop data with various resolutions

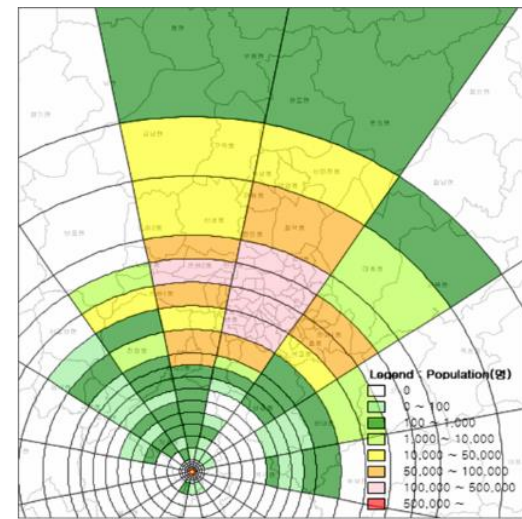
- **Population differences could exist** at population-changeable area
  - Boundaries of administrative districts
  - Area between mountains and flat lands
- It is due to the **change of resolution and center point of the population data** which belongs to the spatial grids of KOSCA-POP



Grid interval 100m



Grid interval 250m

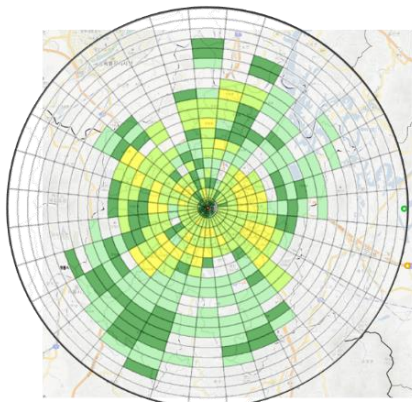


Grid interval 500m

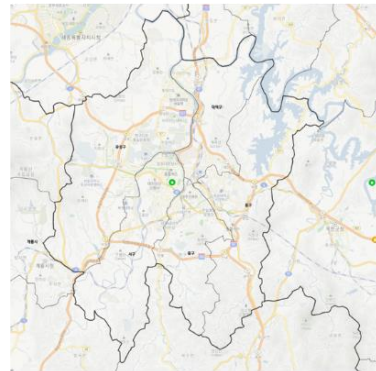
**KOSCA-POP calculation results using POPCON output in a variety of spatial resolutions**

# Application Testing: No resident population

- Testing whether the output of the sectors with no resident population is calculated correctly
  - Population of the **mountains, lakes, and rivers in Daejeon**, where a resident population does not exist, is calculated as **zero**
  - Recognition of **sea and land area including islands in Busan**
- **No significant error** to interface population files between **POPCON** and **KOSCA-POP**

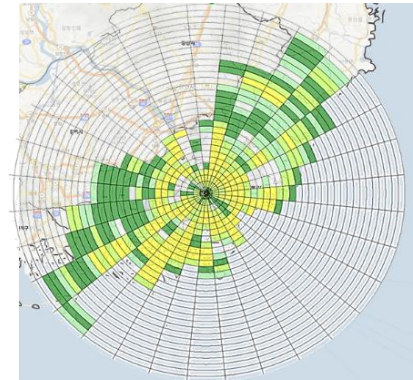


KOSCA-POP Result

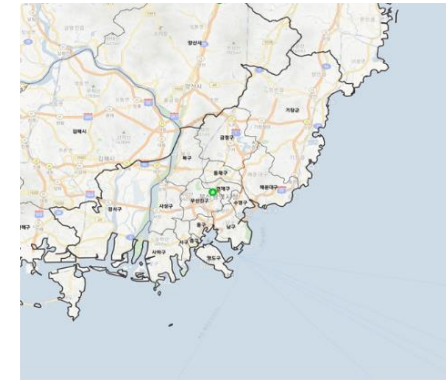


Legal Boundary of Daejeon

Result of KOSCA-POP for Daejeon (resolution: 100m)



KOSCA-POP Result



Legal Boundary of Busan

Result of KOSCA-POP for Busan (resolution: 100m)

# Conclusion

- **POPCON**, a GIS-based population data conversion program, was developed to a pre-processor in order to prepare the site data of a nuclear power plant.
- **Verification testing** confirmed that POPCON operates in conformance with the design requirements.
- **Application testing** validated its applicability to the preprocessing of KOSCA-POP.
- It is apparent that using **population data with higher resolution allows greater fidelity** to produce site input used for a consequence analysis.
- It is confirmed that POPCON software runs appropriately **without error** in order to perform the designed functions such as **file conversion**, **coordinate conversion**, and **compatibility with KOSCA-POP**.

**Thank you.**