


iFUNDit: Visual Profiling of Fund Investment Styles

Bon Kyung KU

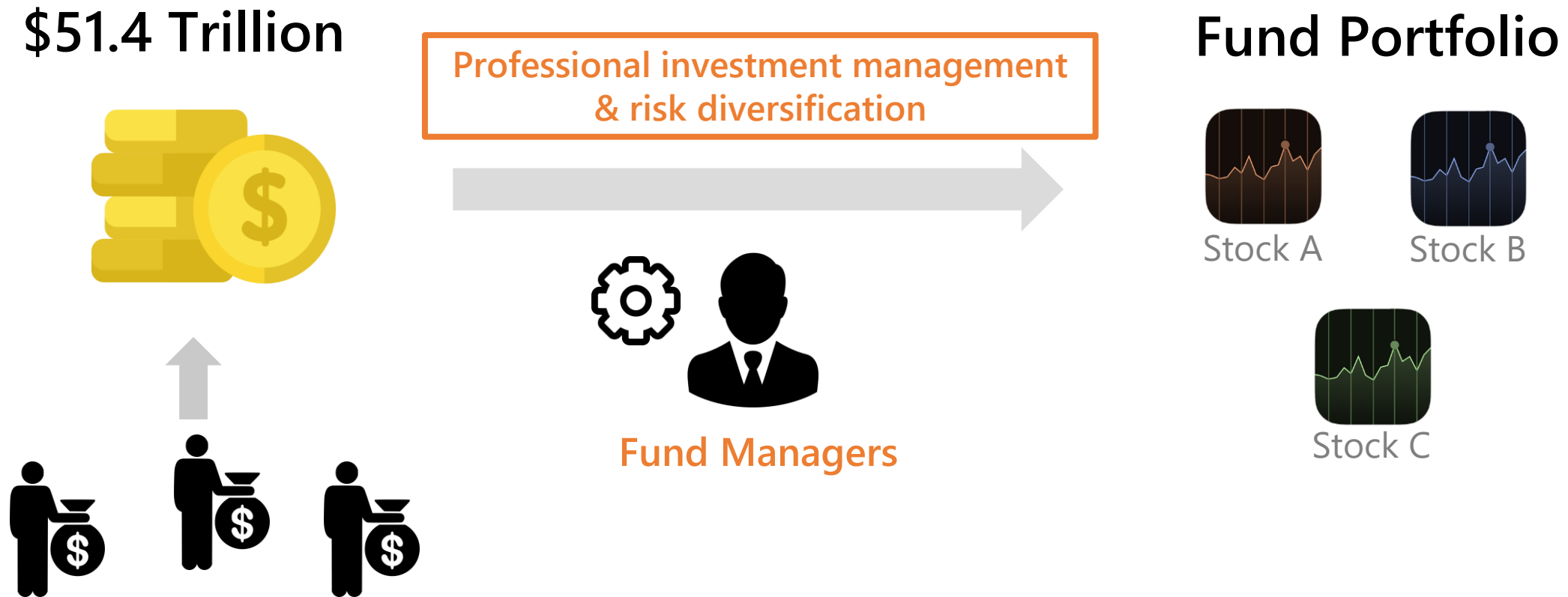
Supervised by Prof. Huamin QU

MPhil Thesis Defense
18th August, 2020

Outline

- 
1. Introduction
 2. Related Work
 3. Contribution
 4. Method
 5. Evaluation
 6. Discussion

Background: Mutual Funds



Fund Investment Style Analysis

- A consensus about investment: there is **no “best” investment strategy**
- Detail analysis should reveal underlying investment strategy of a fund, which **determines its performance**
- Crucial for fund managers and investors

For fund managers

Provide invaluable insights to enhance their investment strategies

For investors

Assess the suitability of funds regarding investors' style preference and risk management.

Introduction

Related Work

Contribution

Method

Evaluation

Conclusion

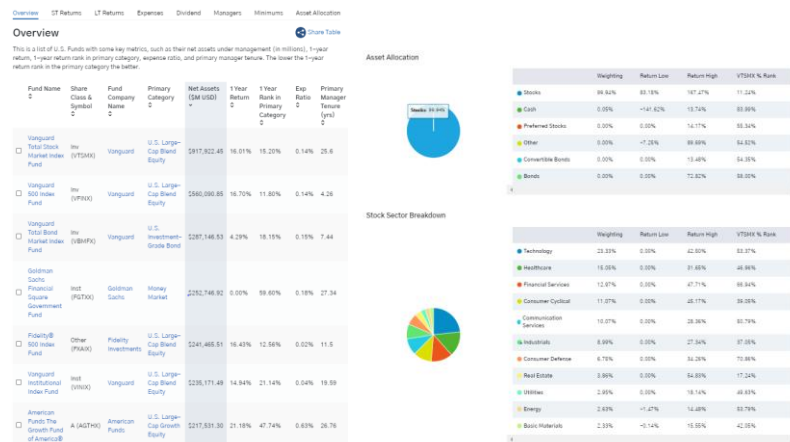
Challenges

1. Due to **high dimensional temporal** data, difficulties in
 - Comprehensive analysis for a single fund
 - Comparative analysis between multiple funds
2. **Bipartite** relationship between funds and managers
3. **No standard model** for evaluation of fund investment style
 - Data mining and machine learning cannot provide direct solutions

Need for visual approaches for fund analysis

Inefficient Conventional Methods

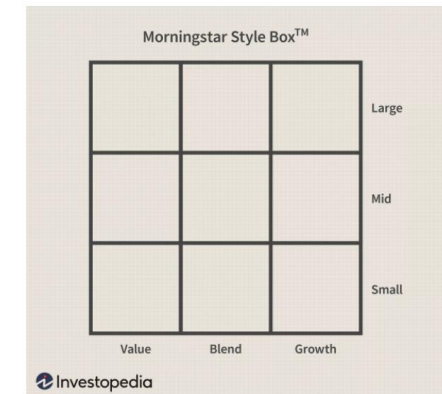
- **Visualization:** Tabular forms and simple charts
- **Exploration:** Query by keywords, sorting, filtering
- **Evaluation:** Quasi-quantitative methods which lack in detail



US Stock-Based Fund Table and Chart
[<https://mutualfunds.com/categories/all-funds/us-funds>]

Fund Name	Share Class	Fund Company	Primary Category	Net Assets (\$M USD)	1 Year Return	1 Year Rank in Primary Category	Expense Ratio	Primary Manager
1. 易方达基金	易方达基金	易方达基金	易方达基金	易方达基金	易方达基金	易方达基金	易方达基金	易方达基金
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China Fund Table
[<http://fund.eastmoney.com/data/fundranking.htm>]



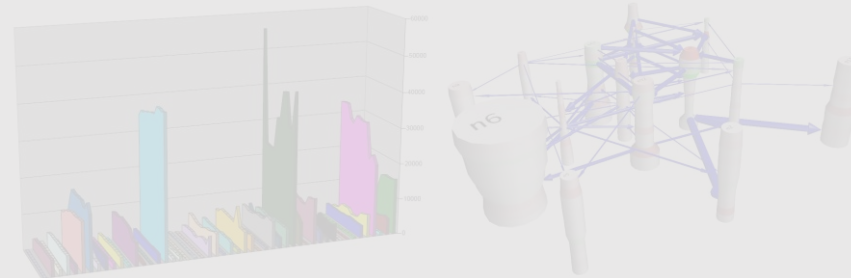
Quasi-quantitative Morningstar Style Box
[<https://www.investopedia.com/articles/basics/06/stylebox.asp>]

Related Works

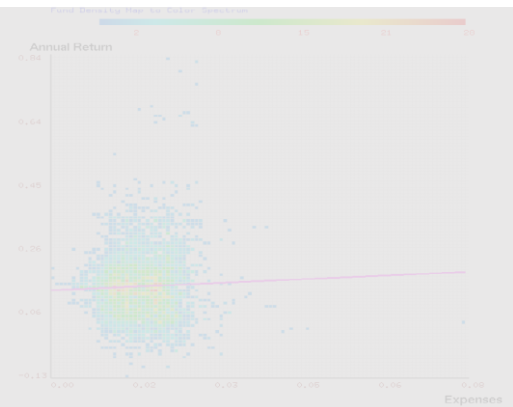
Visualize a fund's investment style
(in terms of stock holdings)



FundExplorer
[Csallner, InfoVis 2003]



A scalable method for
visualizing changes in portfolio data
[Dwyer, PacificVis 2003]

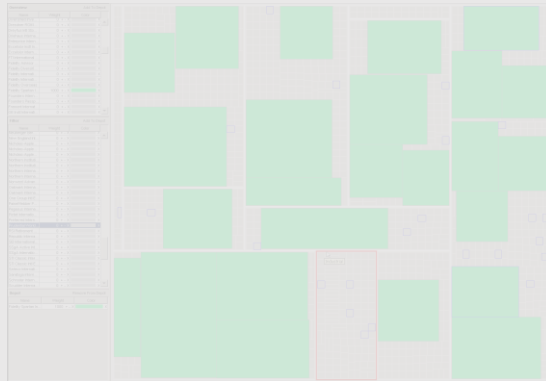


Visual analysis of
mutual fund performance
[Alsakran, InfoVis 2003]

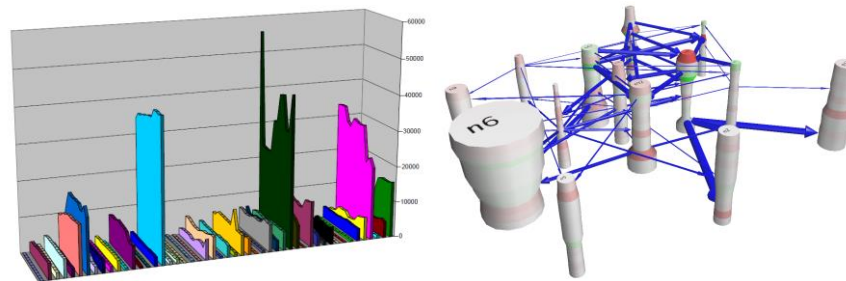
- X Difficult to show evolvement of fund style
- X Does not relate style to performance metrics

Related Works

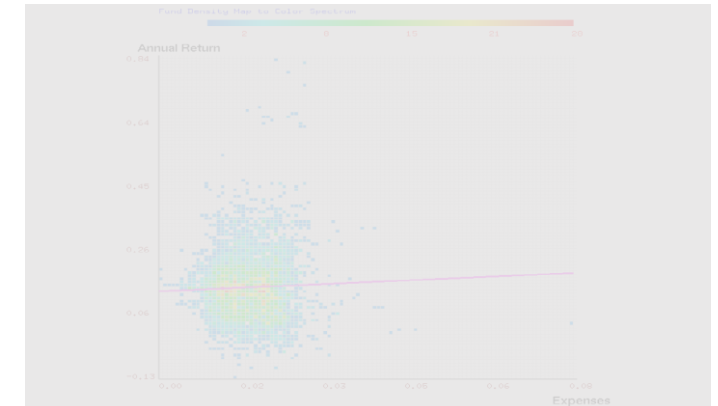
3D representation of fund holdings' performances and evolvement of funds



FundExplorer
[Csallner, InfoVis 2003]



A scalable method for
visualizing changes in portfolio data
[Dwyer, PacificVis 2003]



Visual analysis of
mutual fund performance
[Alsakran, InfoVis 2003]

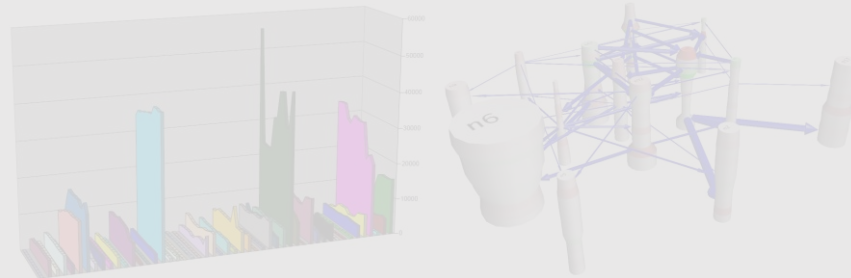
- X Difficult to compare multiple funds
- X Visual clutter in 3D representation

Related Works

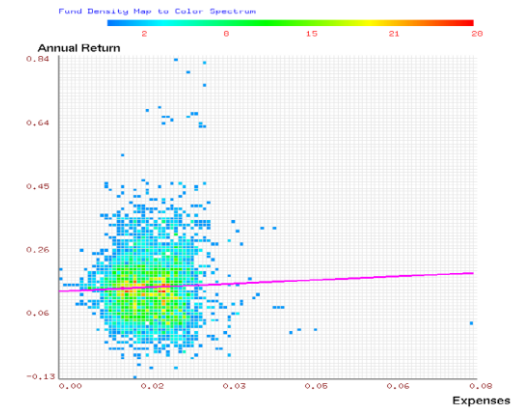
Visualize distribution of multiple funds using different performance metrics



FundExplorer
[Csallner, InfoVis 2003]



A scalable method for
visualizing changes in portfolio data
[Dwyer, PacificVis 2003]

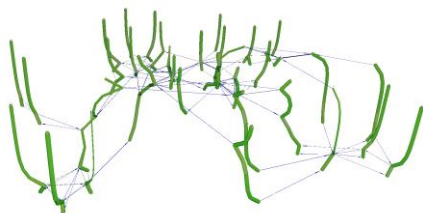
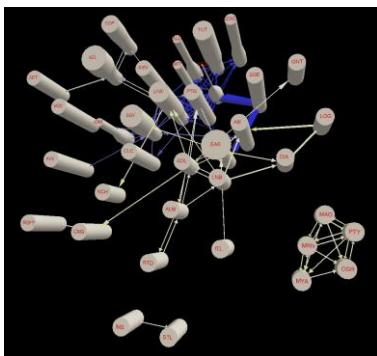


Visual analysis of
mutual fund performance
[Alsakran, InfoVis 2003]

- X Does not relate to investment style
- X No detail investigation for a single fund

Related Works

3D representation of fund manager's trading behavior



**Visualizing a fund manager flow graph
with columns and worms**
[Dwyer, InfoVis 2002]

- X Does not related to performances
- X Does not show relationship between funds and managers

Related Works

Visualization of investment style and performance of portfolio



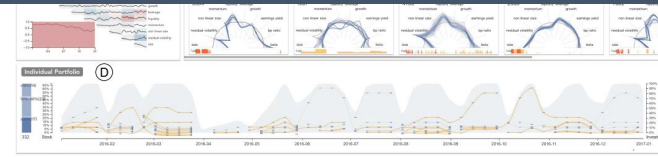
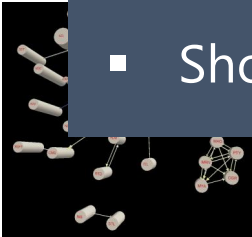
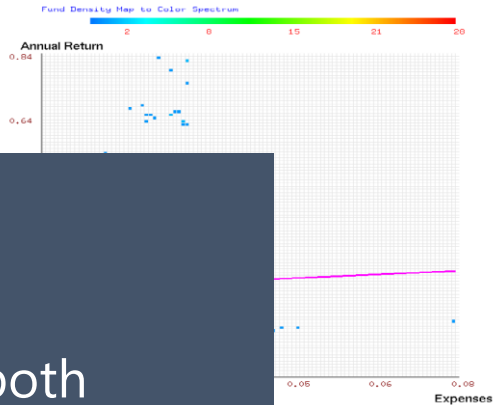
sPortfolio [Yue, TVCG 2019]

- X Limited in showing evolvement of fund investment style
- X Does not depict bipartite relationship of funds and managers

Related Works

No existing works that

- Facilitate analysis of funds from the perspective of both investment style and performances
- Show bipartite relationship of funds and managers



Contribution

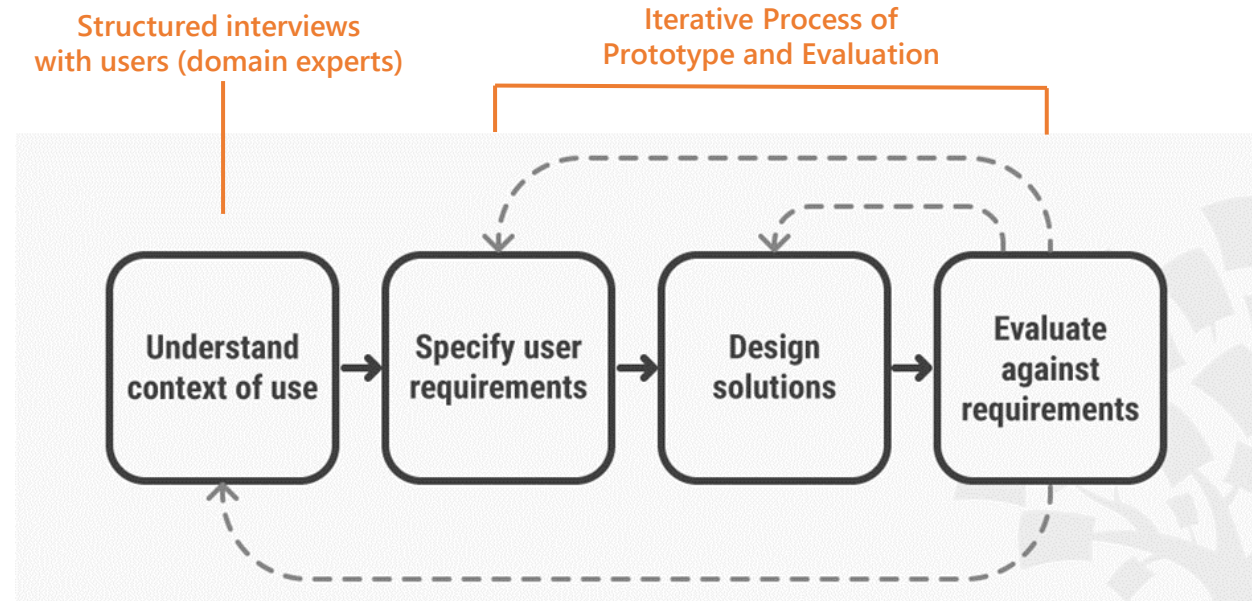
1. A **visual presentation of fund investment style**, that displays the **evolution of a style**, and supports **detailed comparisons** between different styles
2. An **interactive visual analytics system**, iFUNDit, that supports analysis on the **bi-partite relations** of funds and managers, from the perspectives of **performance and investment style**
3. A set of **comprehensive case studies** with domain experts

iFUNDit = “Interactive FUND Investigation Tool”

User-Centered Design

Six domain experts

- Senior fund manager (E1)
- Finance researcher (E2)
- Financial product manager (E3, E4)
- Stock Traders (E5, E6)



Source: <https://www.interaction-design.org/literature/topics/user-centered-design>

Iterative process over 5 months to extract the domain user's requirements

Task Requirements

Single-fund level

T1 – Characterize and visualize the investment style of a fund.

T2 – Show temporal evolution of the investment style of a fund.

T3 – Evaluate the correlation between the investment style and performance of a fund.

Multi-fund level

T4 – Discover similar/different funds, in terms of investment styles or performance metrics.

T5 – Visually compare different investment styles.

T6 – Compare both the performance metrics and investment style of different funds, in the context of reference.

T7 – Display bipartite relationship between funds and managers.

System level

T8 – Enable users to explore using different criteria for evaluating a fund.



Definition of Fund Investment Style

21-Factor Investment Style Metrics

11 Economic Sectors
(Global Industry
Classification Standard)



10 Risk Factors
(Barra China Equity Model)

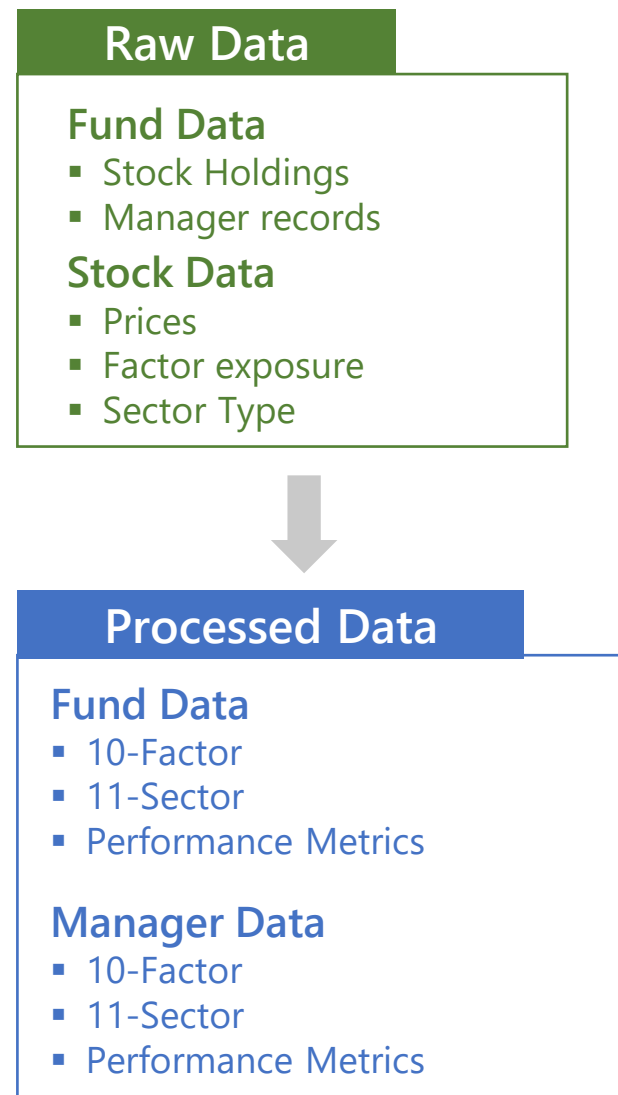


Data

- Real dataset (fund and stock) from RQData API (2008~2019)
- 2398 **stock-oriented** (>60% stocks) China funds
- Processing of style and performance metrics from raw data

Result

- 21-style metrics (quarterly) and performance metrics (daily)



iFUNDit System

“Overview first, zoom and filter, then details on demand.”



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iFUNDit System

“Overview first, zoom and filter, then details on demand.”



iFUNDiT System

“Overview first, zoom and filter, then details on demand.”

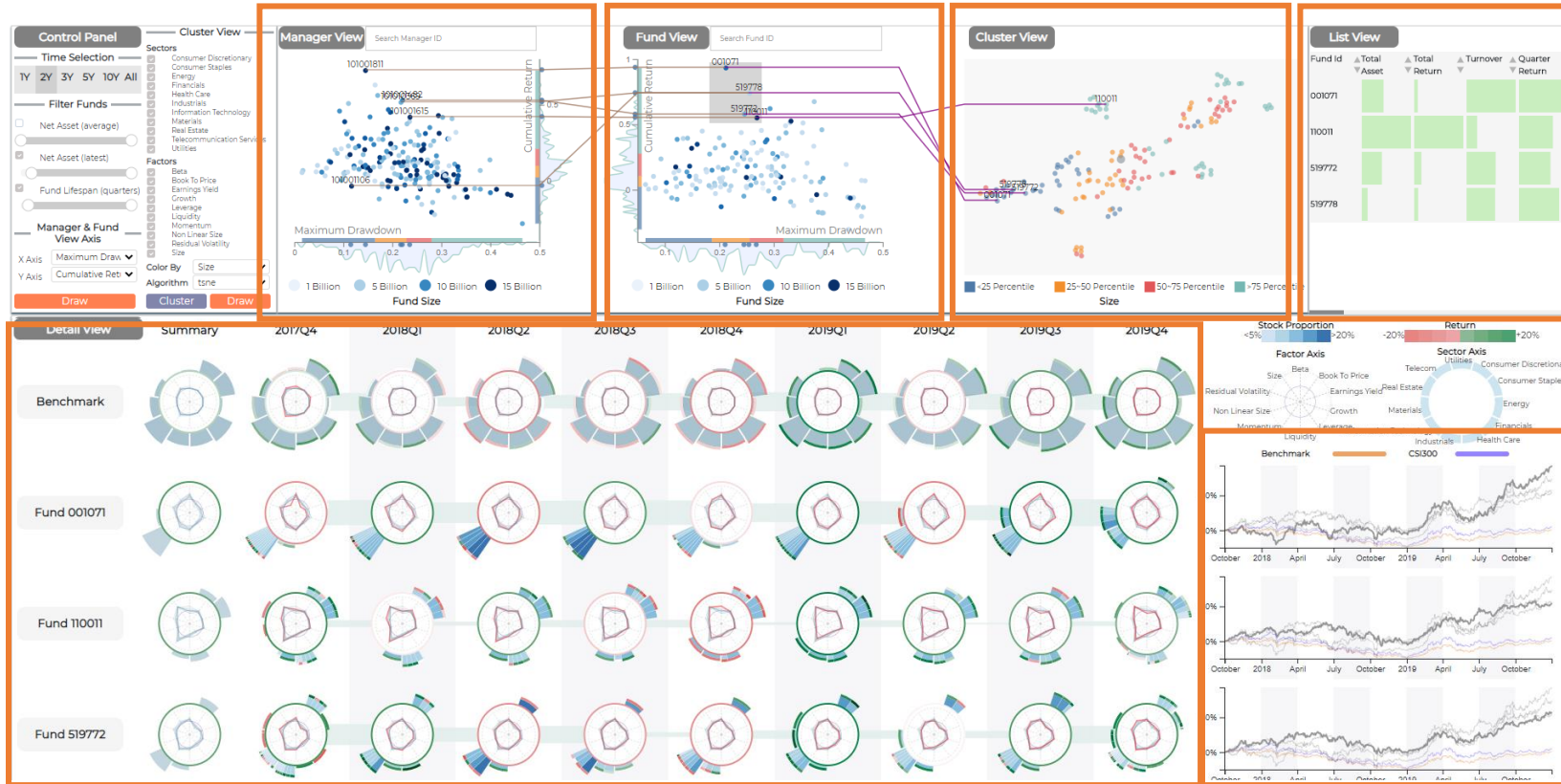


iFUNDit System

“Overview first, zoom and filter, then details on demand.”



iFUNDit System



1. Manager View
2. Fund View
3. Cluster View
4. List View
5. Detail View
6. Temporal View

Introduction

Related Work

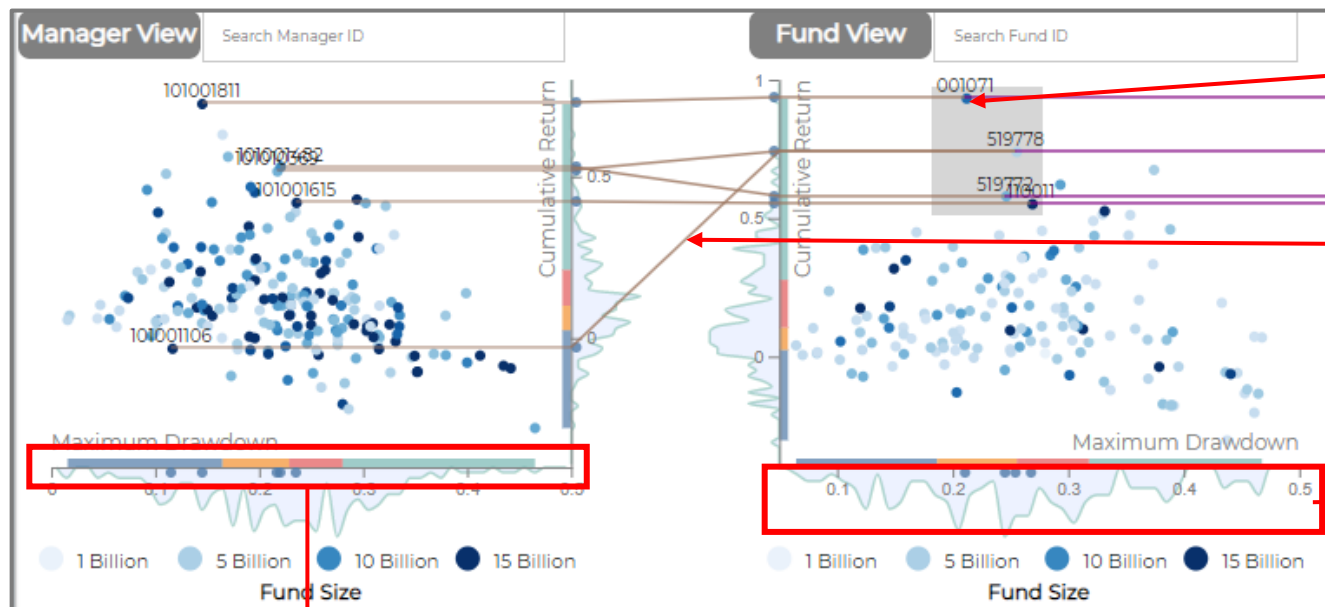
Contribution

Method

Evaluation

Conclusion

Manager / Fund View



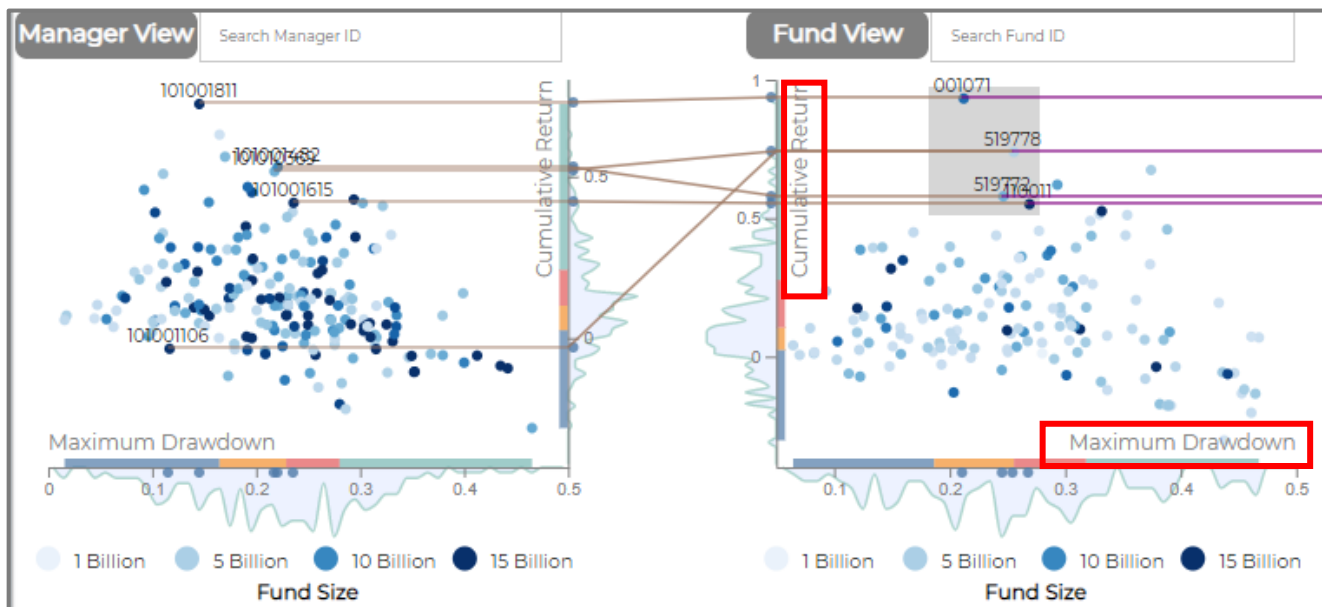
Each dot represents a fund.
Colors of dots encodes fund sizes.

Brown links connect associated funds and managers.
Two views having adjacent axis, it can provide mapping of fund <-> manager performance.

Distribution chart for relative evaluation of performance metrics.

Percentile ribbons for relative evaluation of performance metrics.
4 Percentile Groups (0-25, 25-50, 50-75, 75-100).

Manager / Fund View



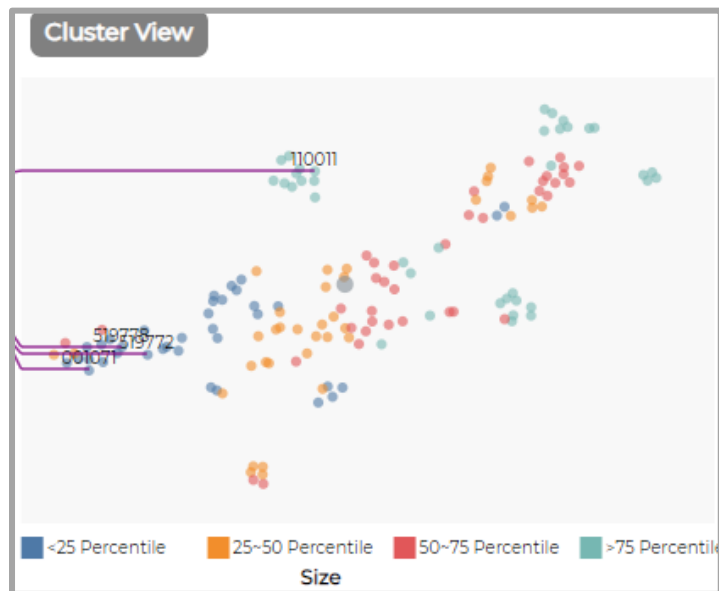
- Shows 2D distribution of funds/managers using different performance metrics [T4, T6]
- Shows bipartite relationship between fund and managers [T7]
- Allow selections of funds/managers for detail analysis



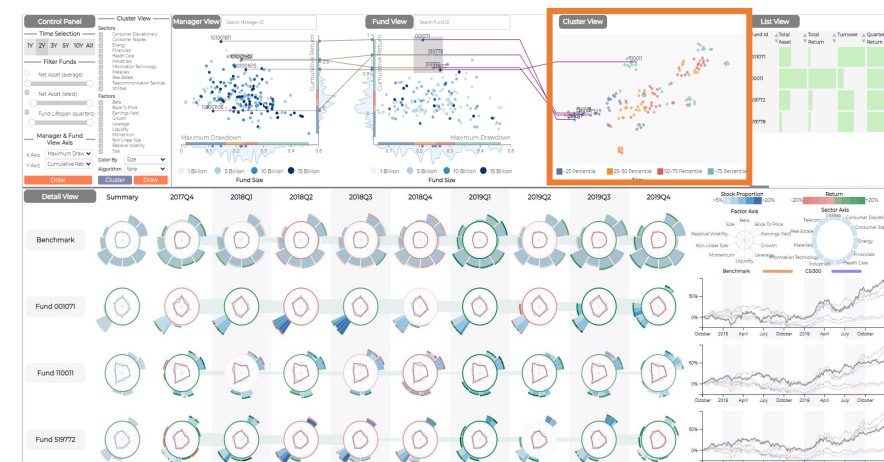
Tasks Addressed

- T4 – Discover similar/different funds, in terms of investment styles or performance metrics.
- T6 – Compare both the performance metrics and investment style of different funds, in the context of reference?
- T7 – Display bipartite relationship between funds and managers.

Cluster View



- Shows 2D projection of funds' investment style by t-SNE or MDS [T4, T5]
- Allow selections of funds for detail analysis



Tasks Addressed

T4 – Discover similar/different funds, in terms of investment styles or performance metrics.

T5 – Visually compare different investment styles.

List View

List View				
Fund Id	▲ Total ▼ Asset	▲ Total ▼ Return	▲ Turnover	▲ Quarter ▼ Return
001071				
110011				
519772				
519778				

List View				
Fund Id	▲ Total ▼ Asset	▲ Total ▼ Return	▲ Turnover	▲ Quarter ▼ Return
001071				
101001811				
110011				
101001615				
519772				
101001482				
519778				
101001106				
101002760				

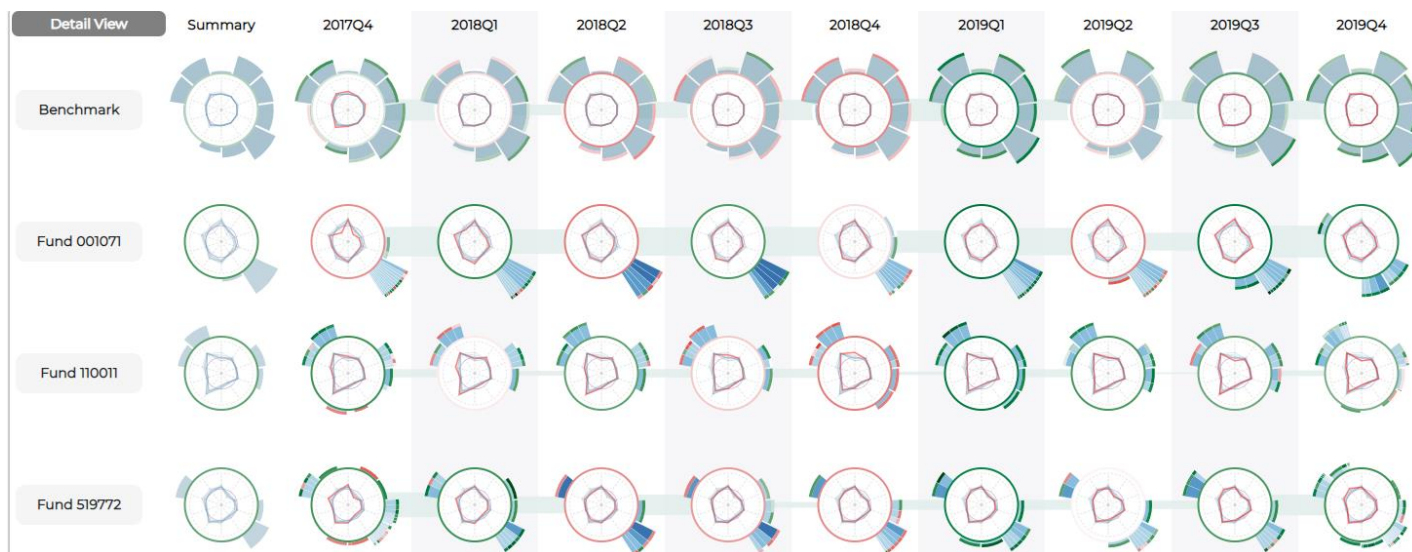


Tasks Addressed

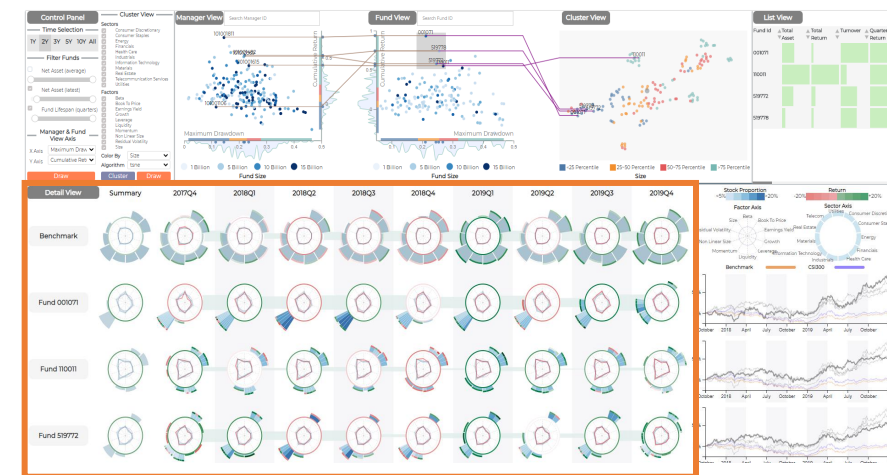
- Allow **comparison of selected funds** with respect to various performance metrics [T6, T8]
- Sorting according to different performance metrics which is synced with Detail View
- Clicking funds will show performance metrics of associated managers [T7]

- T6 – Compare both the performance metrics and investment style of different funds, in the context of reference?
- T7 – Display bipartite relationship between funds and managers.
- T8 – Enable users to explore different criteria for evaluating a fund.

Detail View



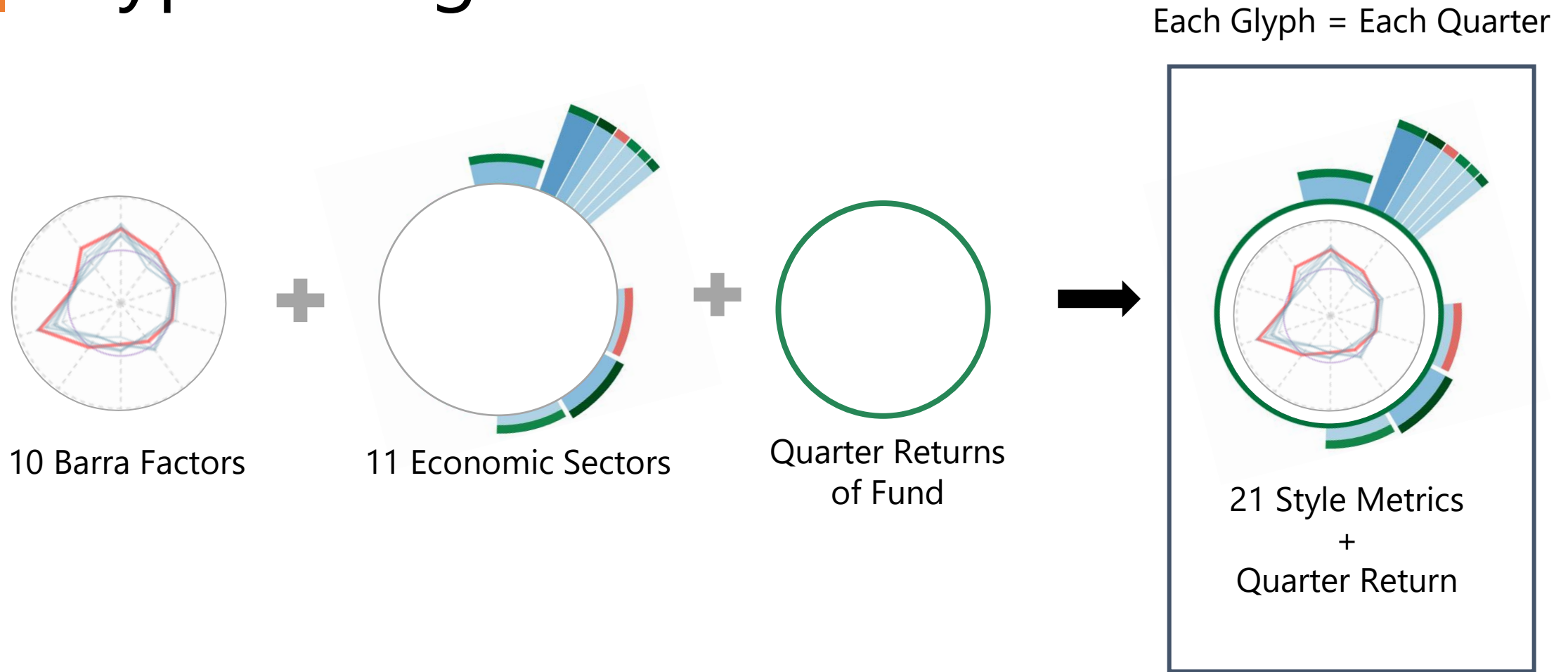
- Visualize evolvement of investment style and performance of a fund using series of glyphs [T1, T2, T3]
- Allow comparison of multiple funds [T6]
- Benchmark on the top allows comparison of a fund **relative to market average** [T6]



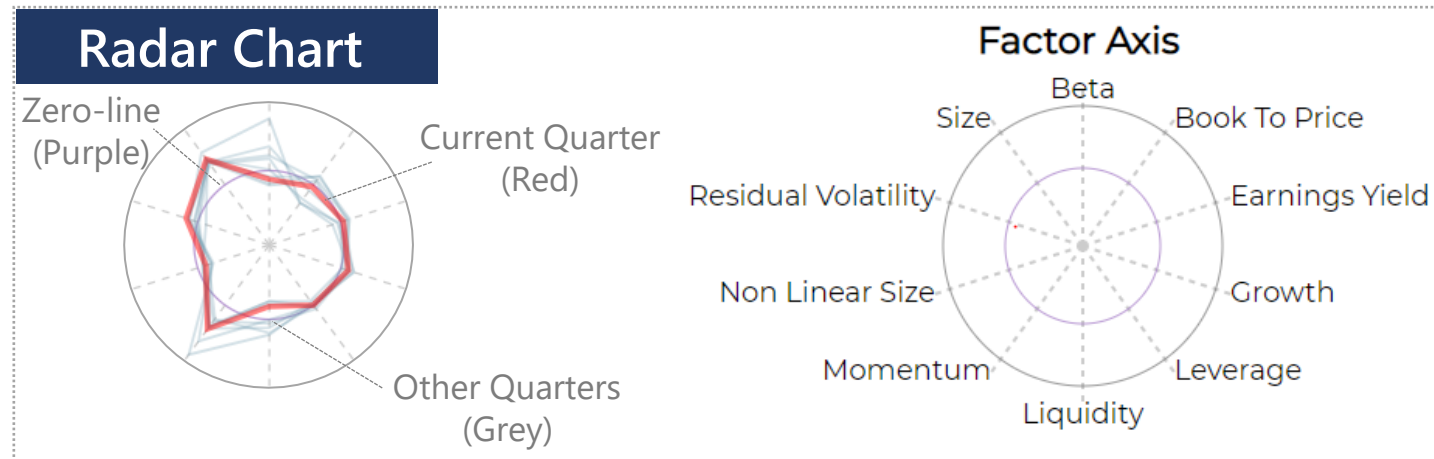
Tasks Addressed

- T1 – Characterize and visualize the investment style of a fund.
- T2 – Show temporal evolution of the investment style of a fund.
- T3 – Evaluate the correlation between the investment style and performance of a fund.
- T6 – Compare both the performance metrics and investment style of different funds, in the context of reference?

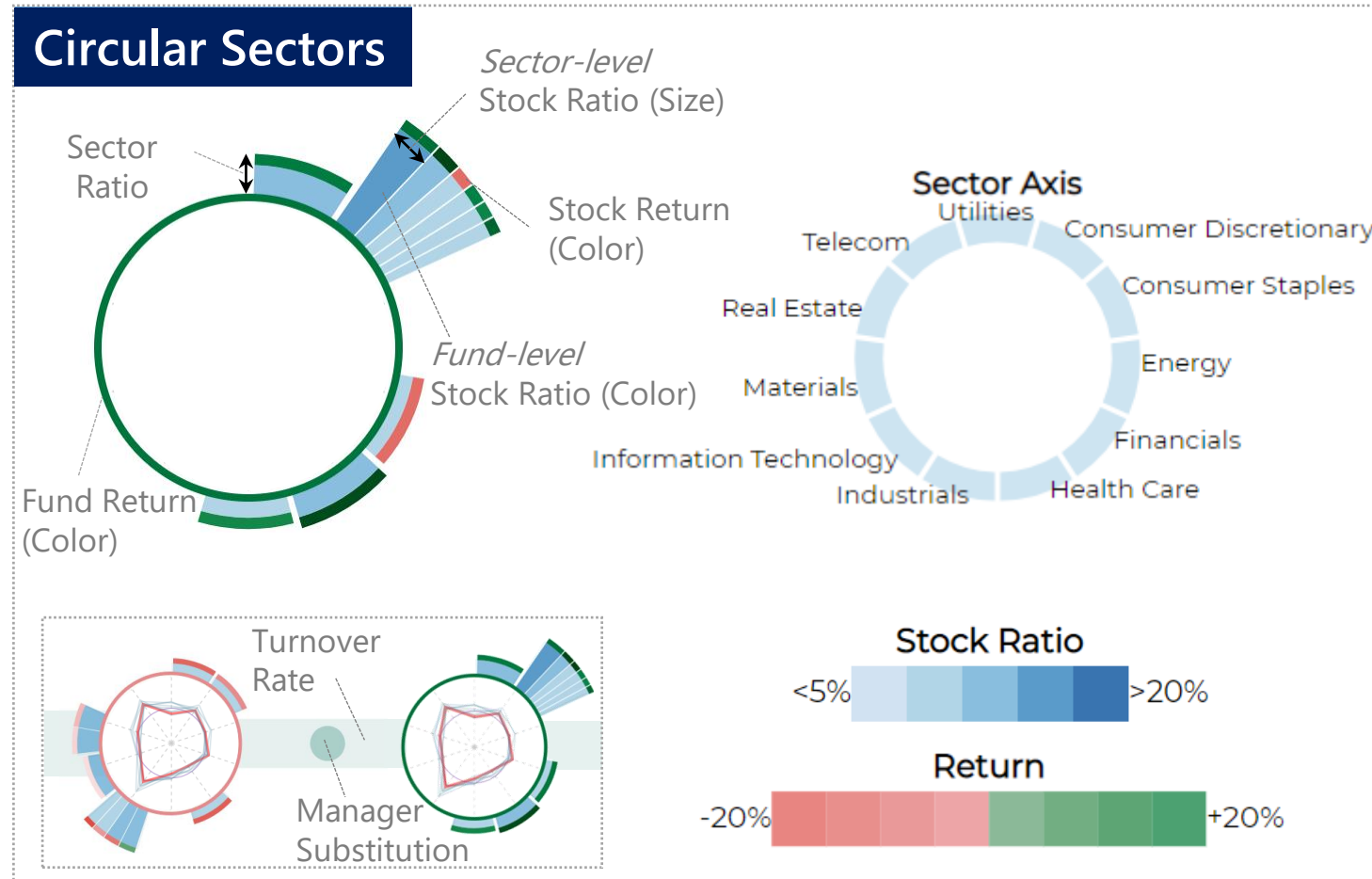
Glyph Design



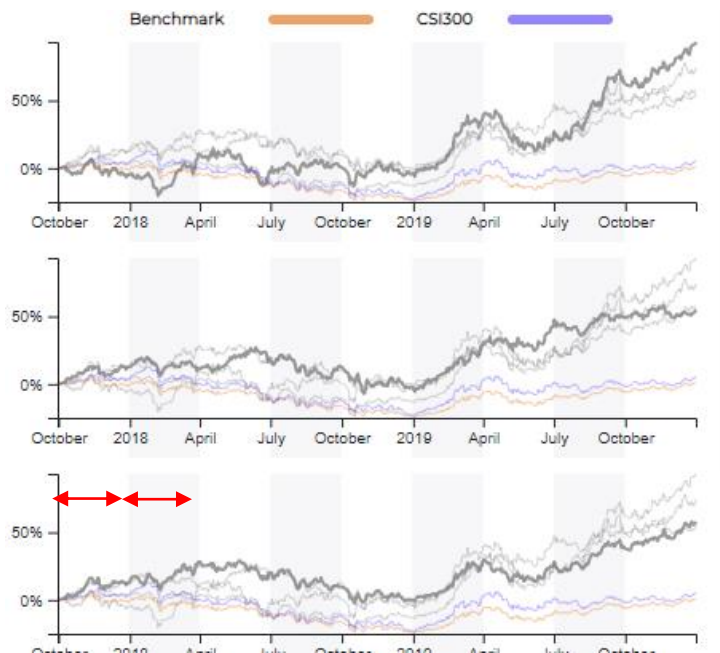
Glyph Design



Glyph Design



Temporal View



- Shows performance of a fund relative to market average, CSI300 Index and other funds [T6]
- Used with detail view to relate investment style and performance of each quarter [T3]



Tasks Addressed

- T3 – Evaluate the correlation between the investment style and performance of a fund.
- T6 – Compare both the performance metrics and investment style of different funds, in the context of reference?

Evaluation

Three case studies with four experts:

- A senior fund manager (E1)
- Financial researcher (E2)
- Two product managers (E3, E4)

Case 1: Investigate the investment styles of good funds

Case 2: Find funds of similar investment styles

Case 3: Analysis the influence of different managers to a fund

Case 1: Investment Style of Good Funds

Settings

1. Fund Filters

- Recent two years data
- Latest Asset Size > \$3 Billion
- Fund history > 2 years

2. Manager and Fund View Axis

- X-axis: Maximum Drawdown (Downward volatility)
- Y-axis: Cumulative Returns

3. Cluster View

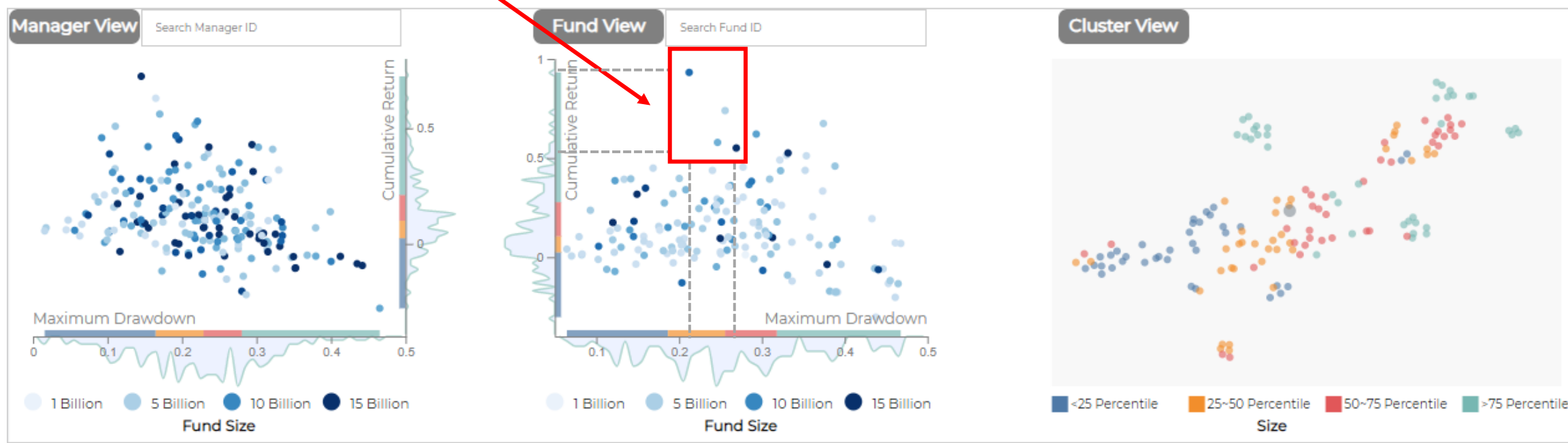
- All style metrics for clustering features
- "Size" risk factor as color label
- t-SNE clustering algorithm

The screenshot shows a web-based interface for fund analysis, divided into three main sections highlighted by red boxes and numbered 1, 2, and 3.

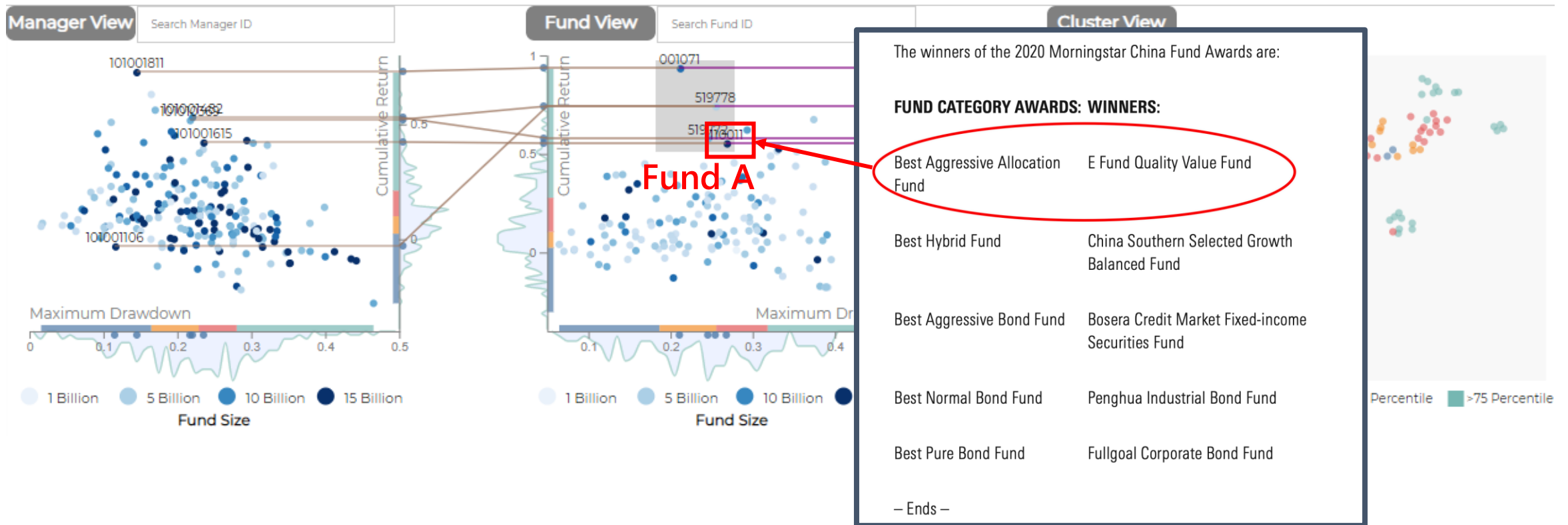
- Section 1 (Control Panel):** Contains 'Time Selection' (1Y, 2Y, 3Y, 5Y, 10Y, All), 'Filter Funds' (checkboxes for Net Asset (average), Net Asset (latest), Fund Lifespan (quarters)), and 'Manager & Fund View Axis' (X Axis: Maximum Draw, Y Axis: Cumulative Reti).
- Section 2 (Manager & Fund View Axis):** Contains a 'Draw' button.
- Section 3 (Cluster View):** Contains 'Sectors' (Consumer Discretionary, Consumer Staples, Energy, Financials, Health Care, Industrials, Information Technology, Materials, Real Estate, Telecommunication Services, Utilities), 'Factors' (Beta, Book To Price, Earnings Yield, Growth, Leverage, Liquidity, Momentum, Non Linear Size, Residual Volatility, Size), 'Color By' (Size), 'Algorithm' (tsne), and 'Cluster' and 'Draw' buttons.

Case 1: Investment Style of Good Funds

High return
Medium risk = Good Performing Funds

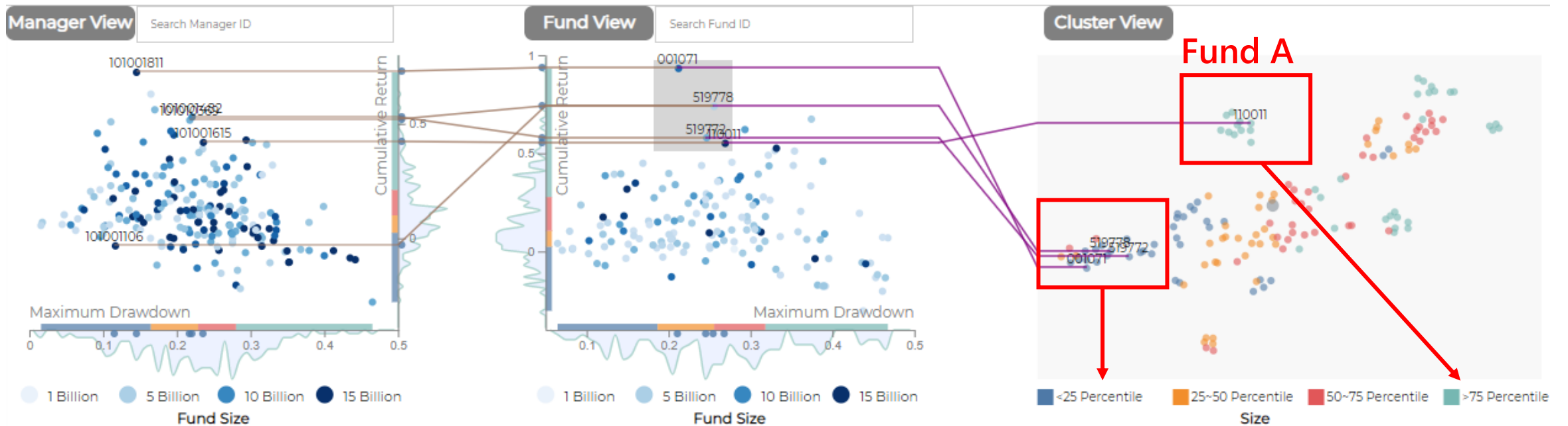


Case 1: Investment Style of Good Funds



[<https://newsroom.morningstar.com/newsroom/news-archive/press-release-details/2020/2020-Morningstar-Fund-Awards-China-Winners-Announced-/default.aspx>]

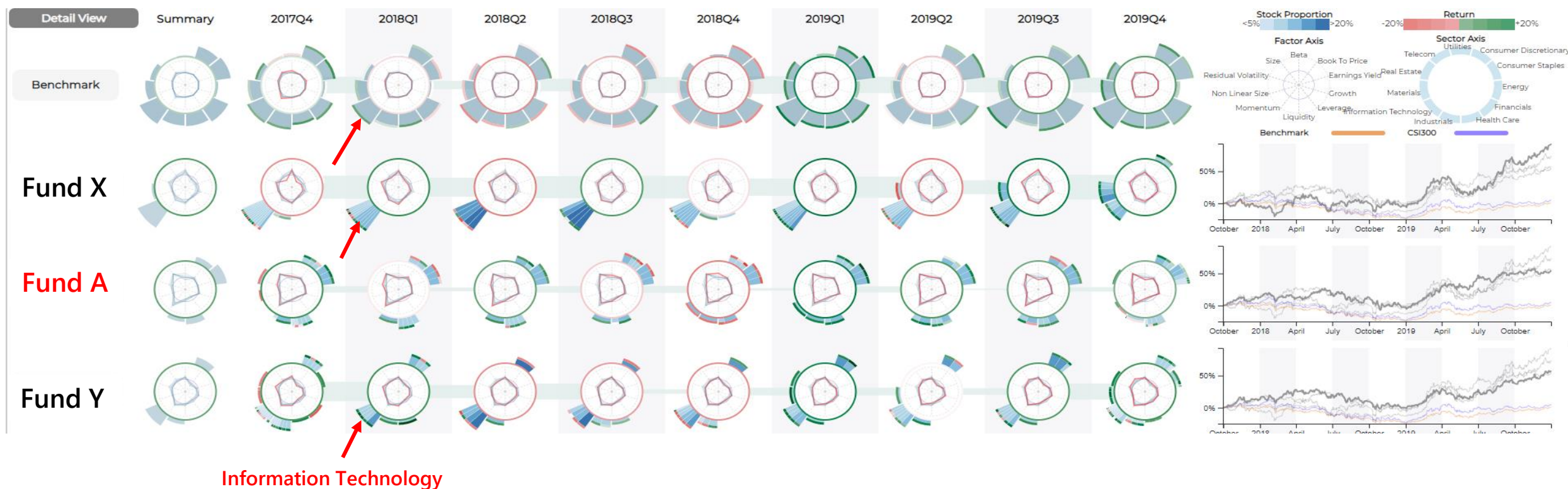
Case 1: Investment Style of Good Funds



Case 1: Investment Style of Good Funds



Case 1: Investment Style of Good Funds



Introduction

Related Work

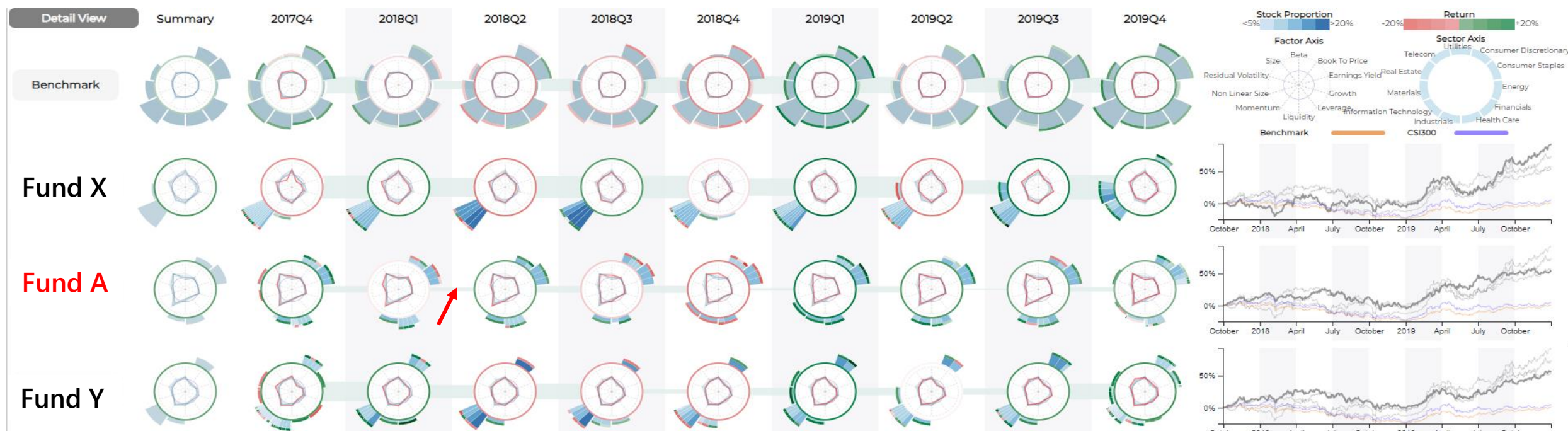
Contribution

Method

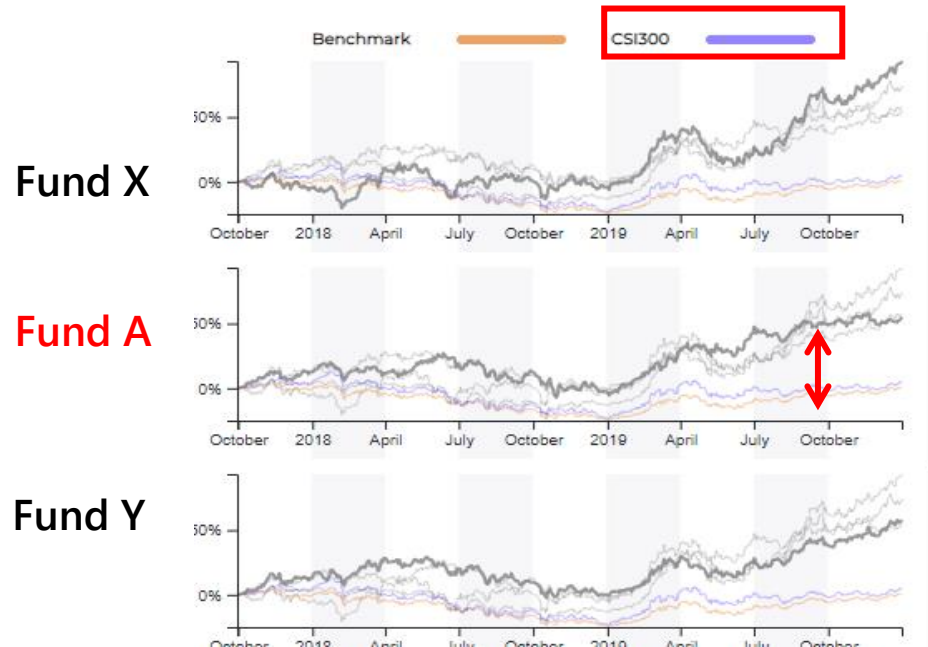
Evaluation

Conclusion

Case 1: Investment Style of Good Funds



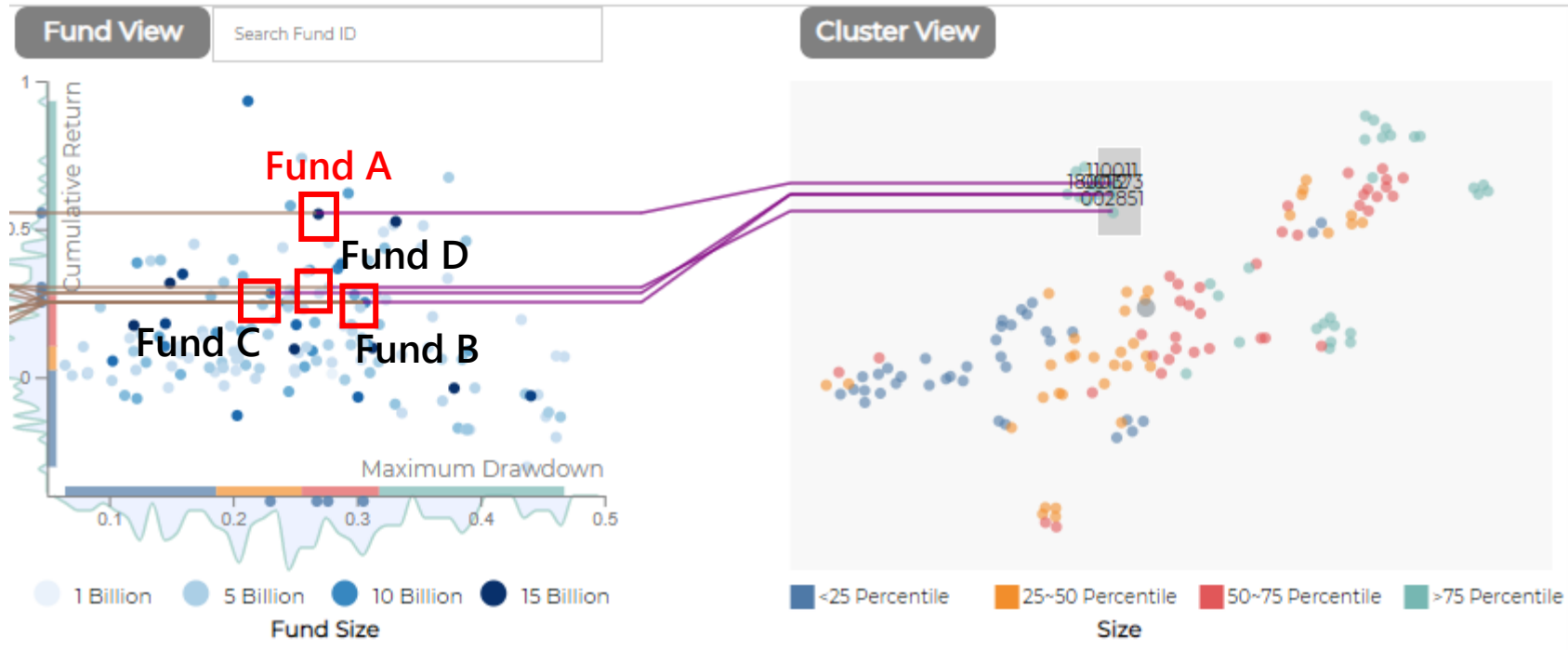
Case 1: Investment Style of Good Funds



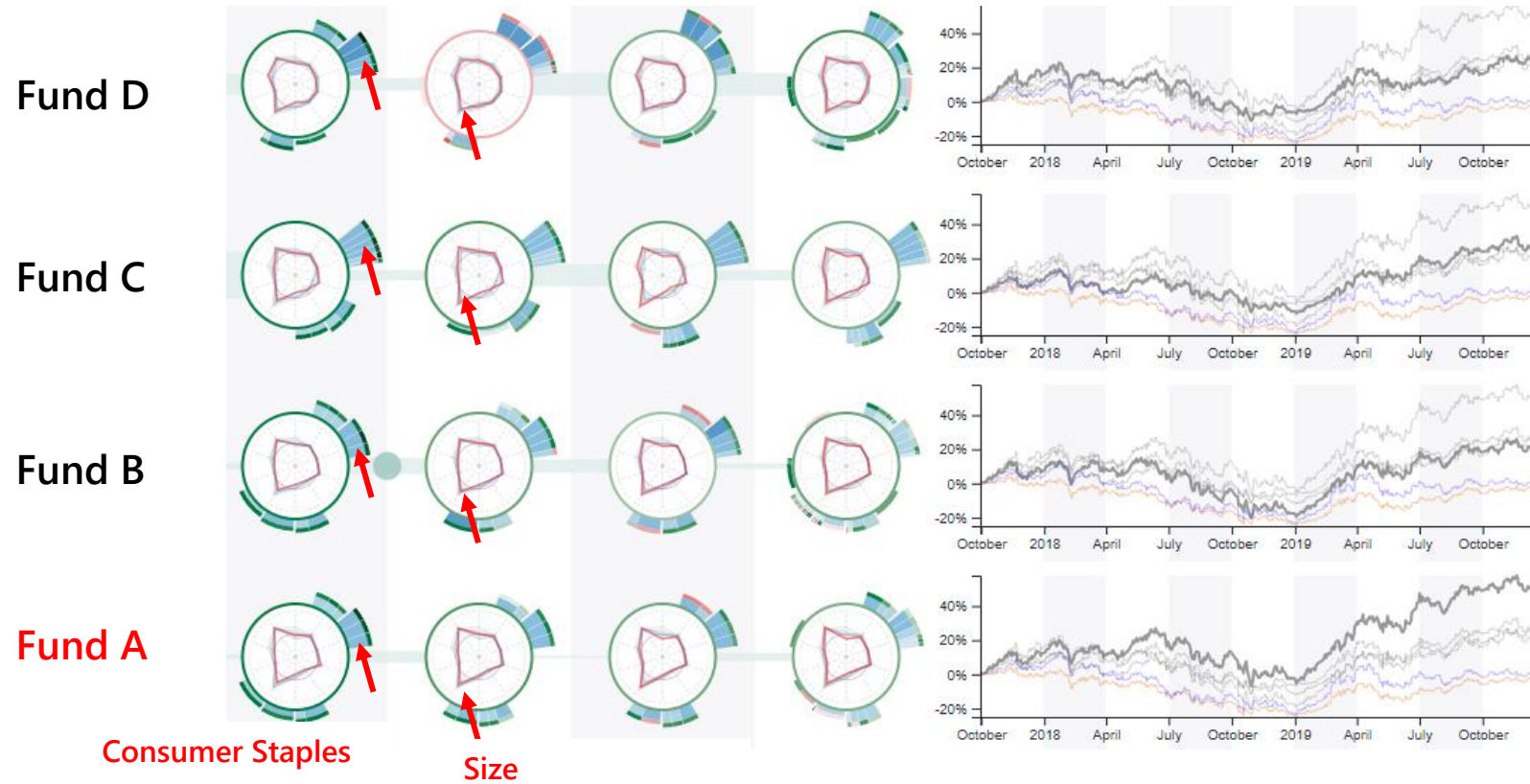
List View					
Fund Id	▲ Total ▼ Asset	▲ Total ▼ Return	▲ Turnover ▼	▲ Quarter ▼ Return	▲
Fund A					
Fund X					
Fund Y					
Fund Z					

From the findings, expert could implicate that Fund A pursued its own strategy: favor **large-cap stock** and adopt **low-frequency** trading

Case 2: Find funds of similar investment styles



Case 2: Find funds of similar investment styles



Case 2: Find funds of similar investment styles

Fund D



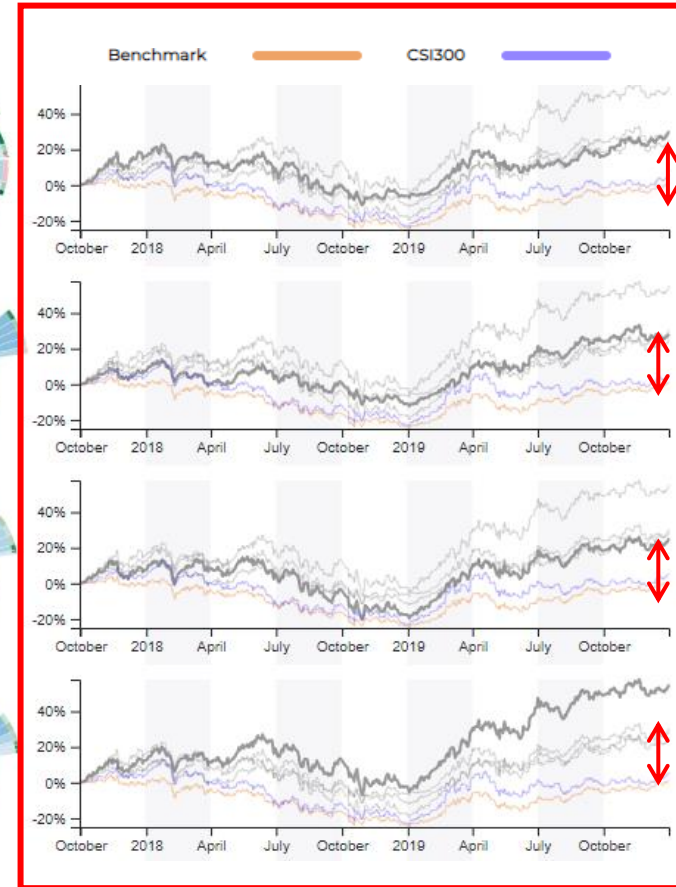
Fund C



Fund B



Fund A



| Discussion

Generalizability

- Applicable for other evaluation models with similar number of factors

Limitations

- System does not explicitly provide label for a fund investment style
- Does not provide link to external factors that affect fund's performance

Future work

- Given data about investors' preferences, provide recommendation of funds

Publications

Conferences

1. Aoyu Wu, **Bon Kyung Ku**, Furui Cheng, Xinhuan Shu, Abishek Puri, Yifang Wang and Huamin Qu, "Pulse: Toward a Smart Campus by Communicating Real-time Wi-Fi Access Data", Workshop on Visualization for Communication, the IEEE Visualization Conference, Berlin, Germany, 2018.
2. Abishek Puri, **Bon Kyung Ku**, Yong Wang and Huamin Qu, "RankBooster: Visual Analysis of Ranking Predictions", EuroVis2020 - Short Papers, Norrkoping, Sweden, 2020.

Pulse Of HKUST



Acknowledgements

- Prof. Huamin QU
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- Pulse Team Members
- Dr. Rong ZHANG and Prof. Yong WANG
- VIS Lab Members
- My family and friends
- All the audiences

Thank you!

Q&A