

# Thesis

Neo

## Abstract

things to put in abstract

## 1 Intorduction

Why Invest  
How do most of peopele invest  
Fundamental analysis  
Technical analysis  
Why technical indicators  
How to optimize the parameters of technical indicators  
Breifly summerize our method

## 2 Related Work

Related Work

## 3 Background

not sure what to write

## 4 Proposed Method

### 4.1 Global-best guided Quantum-inspired Tabu Search Algorithm with Not-gate (GNQTS)

What is GNQTS and its evolution  
Flow chart of GNQTS  
Pseudo code of GNQTS

Explain each step of GNQTS

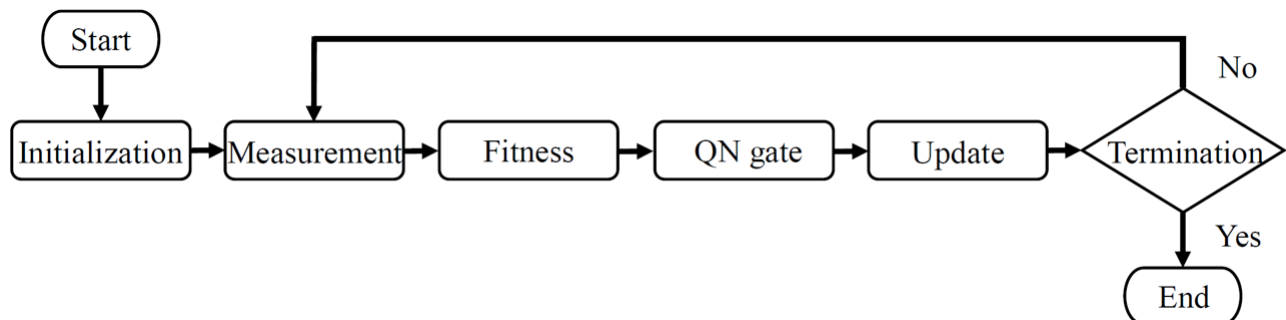


Figure 1: The flowchart of GNQTS

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**Algorithm 1** GNQTS

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```
1:  $i \leftarrow 0$ 
2: Initialize quantum population  $Q(0)$ 
3: Initialize best solution  $b$ 
4: while not termination-condition do
5:    $i \leftarrow i + 1$ 
6:   Produce neighborhood set  $N$  by measure  $Q(i - 1)$ 
7:   Evaluate  $f(s)$ 
8:   Find the best solution  $s^b$  and the worst solution  $s^w$ 
9:   Update  $b$ 
10:  Detect whether GNQTS is stuck in local optimal
11:  if stuck then
12:    Do Quantum Not Gate
13:  end if
14:  Update  $Q(i)$ 
15: end while
```

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Table 1: Tradition MA strategies

Short-term	Mid-term	Long-term
5 days (one week)	20 days (one month)	120 days (half year)
10 days (two weeks)	60 days (three months)	240 days (one year)

## 4.2 Sliding Windows

What are sliding windows

Old sliding sindows

New sliding windows

What can new sliding windows achieve

## 4.3 Technical Indicators

Technical indicators are the rule of thumb or pattern-based signals produced mathematically by the stock price or volume. The fundatioin of technical indicators is the historical prices of the stocks. It is belived that the history will repeated itself as the time extends. In other words, patterns of the market behavior continously appears throughout the history of the stock market. By analyzing the historical data, technical analysis use indicators to determine the timing to buy or sell stocks.

### 4.3.1 Moving Average (MA)

A Moving Average is an indicator that shows the trend of stock price of a company. If the moving average was decreasing, it indicates that the price is falling recently. If the moving average was increasing, it indicates that the price is rising recently. There are several different types of moving averages. The most popular one is the Simple Moving Average (SMA), which is the indicator that is used in this research. The main difference between the moving averages is that the weighting applies to the price of stocks when calculating the indicator.

The most common way to use MA is to compare the relationship between two MA trends, known as crossover. The way to define a crossover is that when plotting two different MA values, the first MA line crosses through the second MA line from the bottom. This is also referred to as a golden cross. On the other hand, a death cross is that when the first MA line crosses through the second MA line of from above. We can simplify the trading strategy of using these two MA into  $MA(MA_1, MA_2)$ . Table 1 shows the parameters of traditional MA that are frequently been use by investors. The combination of the traditional strategy is restricted. Only two types of strategies are allowed, MA(Short-term, Mid-term), MA(Mid-term, Long-term). Hence there are 8 strategies in traditional MA.

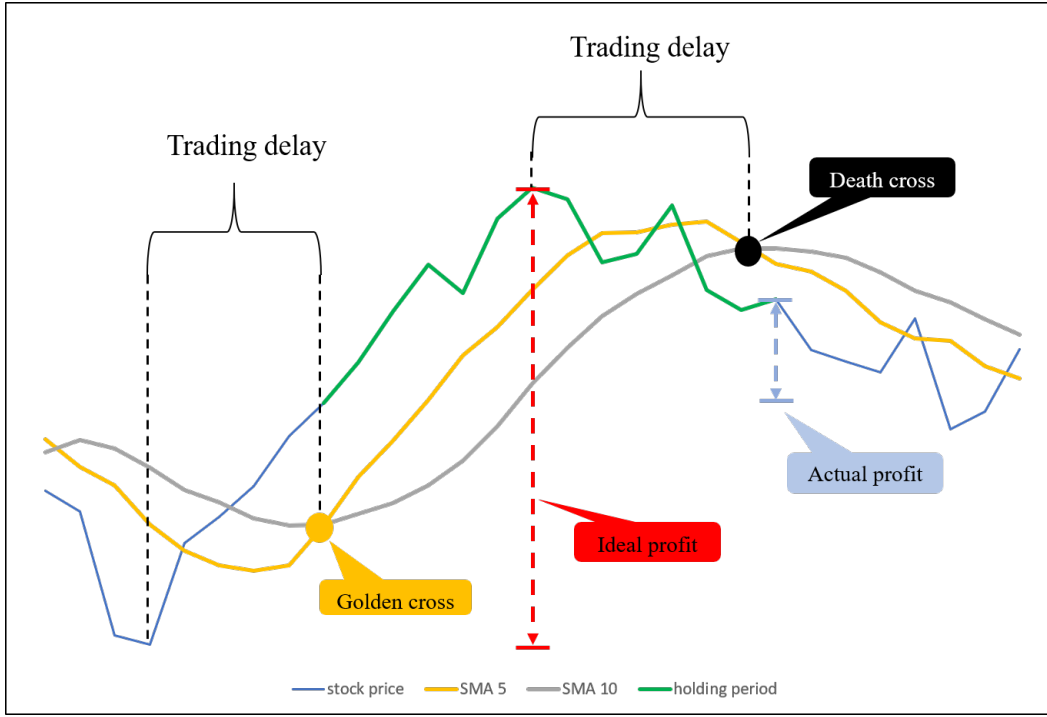


Figure 2: Demonstration of using strategy SMA(5, 20)

Table 2: Comparison of Traditoinal strategy and new MA strategy

	Traditoinal strategy	new MA strategy
strategy	$MA(MA_1, MA_2)$	$MA(MA_{buy_1}, MA_{buy_2}, MA_{sell_1}, MA_{sell_2})$
solution space	8	$256^4$

Among all the MA, SMA is a indicator which can be easily calculated, since the weight which applies to the price of stocks when calculating SMA is equally weighted. SMA is the average closed price of a certain period of time (e.g., 5 days). The period of days that is been used to calculate the average price is called look-back period. The formula of SMA is shown in 1, where  $N$  is the look-back period and  $T$  is the date of today.

$$SMA_N = \frac{price_{T-N} + price_{T-N+1} + price_{T-N+2} + \dots + price_{T-2} + price_{T-1}}{N} \quad (1)$$

Figure 2 demonstrate the timing of golden cross and death cross when using SMA(5, 20). A buy signal is triggered when a golden cross appears. A selling signal is triggered when a death cross appears. These two types of crossover are the important signal to determine the timing of buying or selling the stocks.

Even though MA is a popular investment indicator, there are still some downsides. The first issue is that moving average is a lagging indicator. As we can see in figure 2, the golden cross and death cross are lagging behind the best time to buy or sell shares, leading to lower profits. The second issue is that there are too few traditional strategies. It is difficult to make a profit with just those few strategies. The third problem has to do with the lack of parameters. MA uses just two parameters to find the golden cross and the death cross. Using the same parameters to buy and sell does not appear to be sufficient.

In order to break the boundaries of traditional MA strategy and find more accuate buying and selling point, this study extends the parameters of MA. There will be four parameters, two for buying and two for selling, rather than jus two for buying and selling. In addition, the parameters can be selected from 1 to 256, instead of choosing from short-term, mid-term and long-term. This significantly increases the number of strategies from 8 to  $256^4$ . More than 4.2 billion strategies that can be selecte when using MA as indicator. Comparison of Traditoinal strategy and new MA strategy are shown in table 2.

### 4.3.2 Relative Strength Index (RSI)

#### What is RSI

Relative Strength Index (RSI) is a momentum oscillator that was first introduced by J. Welles Wilder, Jr. [3] in 1978. This is a popular indicator in financial technical analysis for calculating the recent price changes. RSI regards a rising stock price as strength from buyers, a falling price as strength from sellers, and the closing price is the outcome of the relative strength of buyers and sellers.

#### How to use RSI

#### Characteristics of RSI

#### RSI formula

Here are the formulae for calculating RSI. The calculating process can be divided into two steps. For step one (as shown in formulae 2), the average gain and loss is the average of rise and drop respectively during the look-back period. As for step two, with the RSI in step one, we can recursively calculate the next RSI using formula 2, where  $N$  is a parameter, representing a look-back period. The formulas for calculating RSI are as follows.

$$RSI_{step\ one} = 100 - \left[ \frac{100}{1 + \frac{Average\ gain}{Average\ loss}} \right] \quad (2)$$

$$RSI_{step\ two} = 100 - \left[ \frac{100}{1 + \frac{Previous\ Average\ Gain \times (N - 1) + Current\ Gain}{-(Previous\ Average\ Loss) \times (N - 1) + Current\ Loss}} \right] \quad (3)$$

## 4.4 Normalize Internal Rate of Return

How to evaluate the performance of our method

## 5 Experiment Result

### 5.1 Experimental Enviroment

Computer spec

### 5.2 Parameters of GNQTS

Initial funds

Test period

Delta

Particle amount

Experiment number

Iteration number

## **5.3 Training Period**

### **5.3.1 SMA**

### **5.3.2 RSI**

### **5.3.3 SMA combine RSI**

### **5.3.4 Result of Training Period**

## **5.4 Test Period**

### **5.4.1 SMA**

### **5.4.2 RSI**

### **5.4.3 SMA combine RSI**

### **5.4.4 Result of Test Period**

## **5.5 Self-Analysis**

not sure what to write

## **6 Conclusion**

Conclusion

## **7 Reference**

Reference