

# HTML5：弹簧欠阻尼振动

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# 设计思路

## 无阻尼弹簧

$$\frac{d^2x}{dt^2} + \omega^2 x = 0$$

$$x = A \cos(\omega t + \varphi_0)$$

## 欠阻尼的弹簧

$$\frac{d^2x}{dt^2} + 2\beta \frac{dx}{dt} + \omega_0^2 x = 0$$

$$f = -\lambda v = -\lambda \frac{dx}{dt} \quad x(t) = A_0 e^{-\beta t} \cos(\omega t + \varphi)$$

$$\beta = \frac{\lambda}{2m} \quad \omega_0 = \sqrt{\frac{k}{m}}$$

# 设计思路

```
function start(){
    if(pause){
        pause=false;
        setInterval(run,10);
    }
}
function run(){
    if (!pause){
        ctx.clearRect(0, 0, 500, 300);
        pic.w = (pic.w0-300) * Math.exp(-0.22 *
        timer += 0.001;
        dra();
    }
}
```

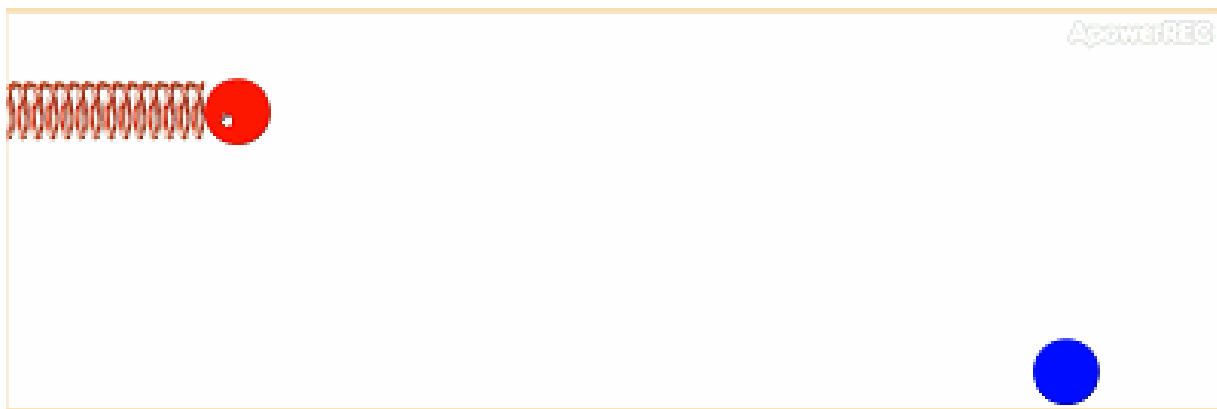
```
canvas.onmousedown=function(e){
    var cor=windowToCanvas(e.clientX,e.clientY);
    if(isPointInImgR(cor)&&pause){
        dragging=true;
        mousedown.offsetX=pic.w-cor.x;
    }
};
canvas.onmousemove=function(e){
    let cor=windowToCanvas(e.clientX,e.clientY);
    if (dragging){
        canvas.style.cursor="pointer";
        updatewid(cor);
        setInterval(run2(),1);
    }
    else{
        if(isPointInImgR(cor)&&pause){
            canvas.style.cursor='pointer';
        }
        else{
            canvas.style.cursor='auto';
        }
    }
};
canvas.onmouseup=function(e){
    if(dragging){
        dragging=false;
        var cor=windowToCanvas(e.clientX,e.clientY);
        updatewid0(cor);
        start();
    }
}
```

# 设计改进



```
ctx.beginPath();  
ctx.moveTo(ori.x, ori.y);  
ctx.lineTo(ori.x+0.15, pic.w-300+100);  
ori.x+=0.15;  
ori.y=pic.w-300+100;  
ctx.lineWidth=1;  
ctx.strokeStyle="black";  
ctx.stroke();
```

# 设计改进



可以控制弹簧弹开红球，模拟弹开后的物理情景，显示一定长度预测的轨迹。用户尽力控制红球碰撞到蓝球，对话框显示 You success!

```

function run(){
  if (!pause){
    cleararc();
    beta=gamma/2;
    omega=Math.round(Math.sqrt(k*k-beta*beta));
    //alert(beta);
    //alert(omega);
    pic.w = (picw0-300) * Math.exp(-beta * (timer)) * Math.cos(omega * (timer)) + 300;
    timer += 0.001;
    dra();
    if(timer>=timer2) {
      out = true;
      timer1 += 0.001;
      updateCircle();
      drawCircle();
      if((circle.x-circle2.x)*(circle.x-circle2.x)+(circle.y-circle2.y)*(circle.y-circle2.y)<=10000){
        alert('You success!');
        pause=true;
        window.location.reload();
      }
      if(circle.x>1950||circle.y>650){
        alert('You fail');
        pause=true;
        window.location.reload();
      }
    }
  }
  else{
    updateCircle();
    drawCircle();
  }
}

```

# 改进

- 可以
- 可以通过数值解法解振动微分方程模拟临界阻尼与过阻尼情况。



谢谢大家