

Swiping/pulse portable nozzle rainfall simulator

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Feel free to discuss with us any questions you might have by text- or video-chat

Introduction

There are numerous types of small and big rainfall simulators with various constructions motivated by:

- Observed surface and subsurface processes
- Rainfall intensity and kinetic energy
- Size of experimental area
- Type of droplet generation

We have developed new type of small rainfall simulator with possibility of using swiping or pulse system

Motivation

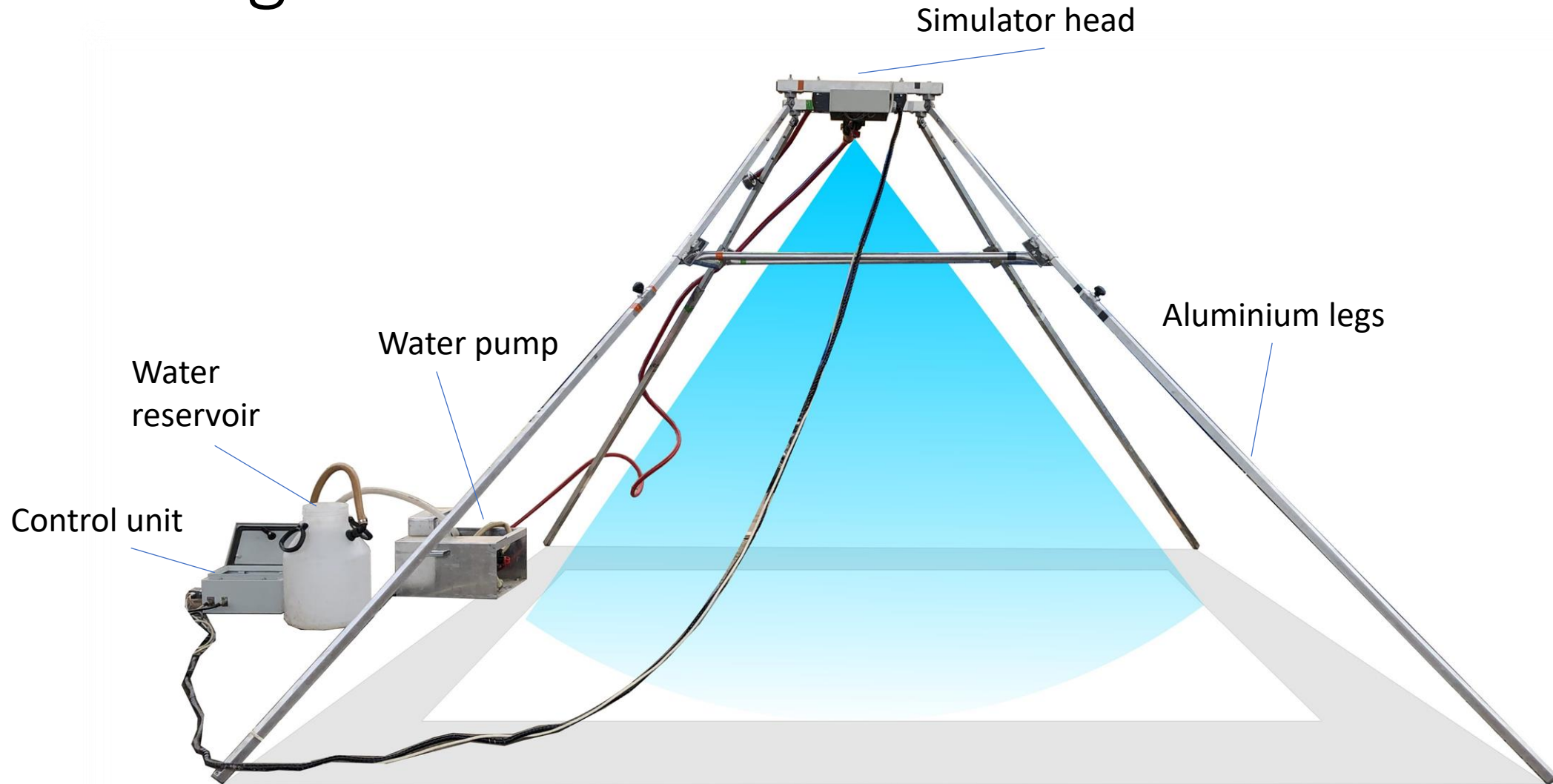
Set of properties desired from the new design:

- Easy to transport and operable by 2 persons
- Replaceable nozzle to provide various intensity and kinetic energy
- Contain swiping system and also pulse system (stationary nozzle)
- Low water consumption
- Tested area up to 2x2 m
- Christiansen distribution >80-90%

Concept

- One nozzle is placed above the middle of plot in 2 or 2,5 m height.
- Nozzle is connected to water supply through solenoid valve and, on opposite side, to the step motor
- Solenoid valve interrupts the water flow (when its not used) to save water consumption
- Swiping can be stopped in the middle position for stationary nozzle type (pulse system)

Design



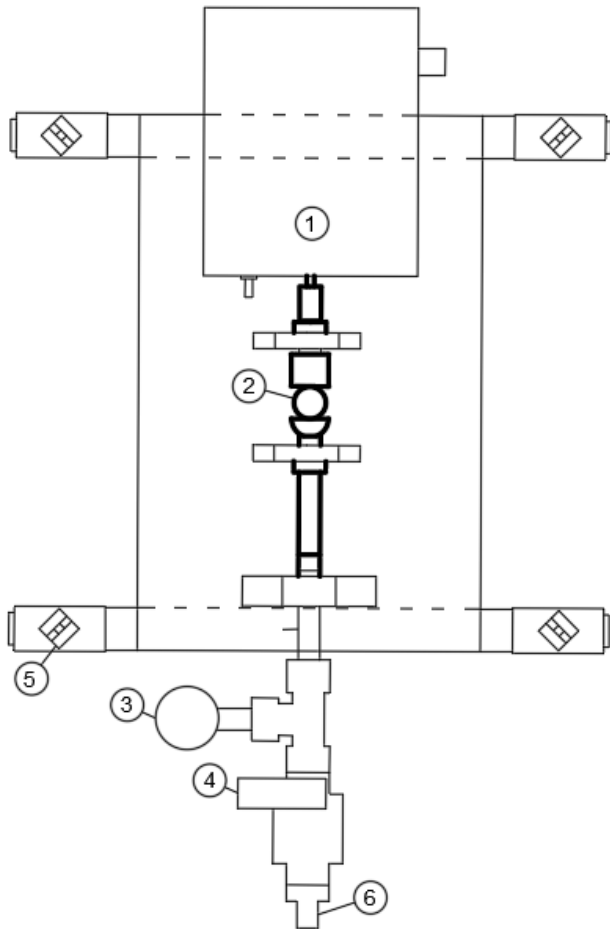


Parts

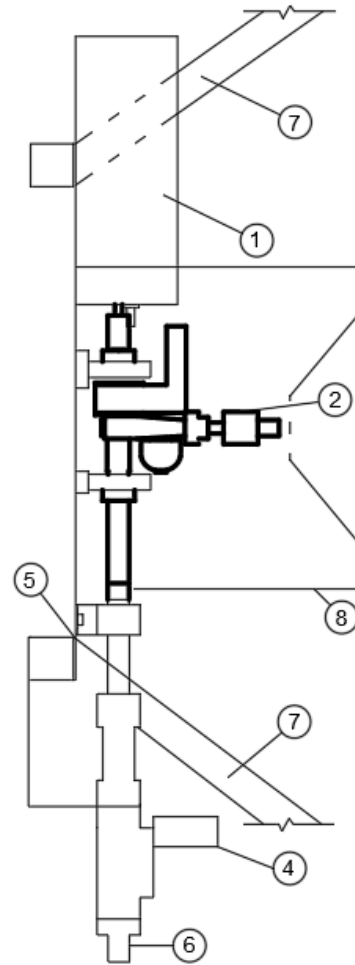
- Simulator head (step engine, nozzle, solenoid valve)
- Electricity supply – gas electric generator
- Water pump – 220 V electric water pump with discharge 12l/min and pressure 1,5 Bar
- Bearing construction – aluminium construction
- Control unit – waterproof box with unit to set rainfall parameters
- Drainage box

Simulator head design

Bottom view



Side view



Legend:

- 1 Waterproof box with step motor
- 2 Nozzle
- 3 Manometer
- 4 Solenoid valve
- 5 Aluminium leg connection
- 6 Connection to water supply
- 7 Aluminium leg
- 8 Drainage box

Control unit

Simple unit for outdoor use to control the parameters of the rainfall.

Following parameters can be set:

- Experiment duration (min)
- Swipping speed (% of maximum speed)
- Angle of opening solenoid valve (°)
- Angle of swipping (°)
- Pause between swipes (sec)
- **Next program**

By changing swipping speed and/or pause is possible to set various intensity with the same nozzle.

By stacking more programs it's possible to simulate variable rainfall intensities.

Drainage box

- A box is placed under the nozzle that collects water that would be otherwise sprayed out of the plot. Collected water flows back through the hose to the storage tank and stays available for the simulator, thus saving substantial amount of water.

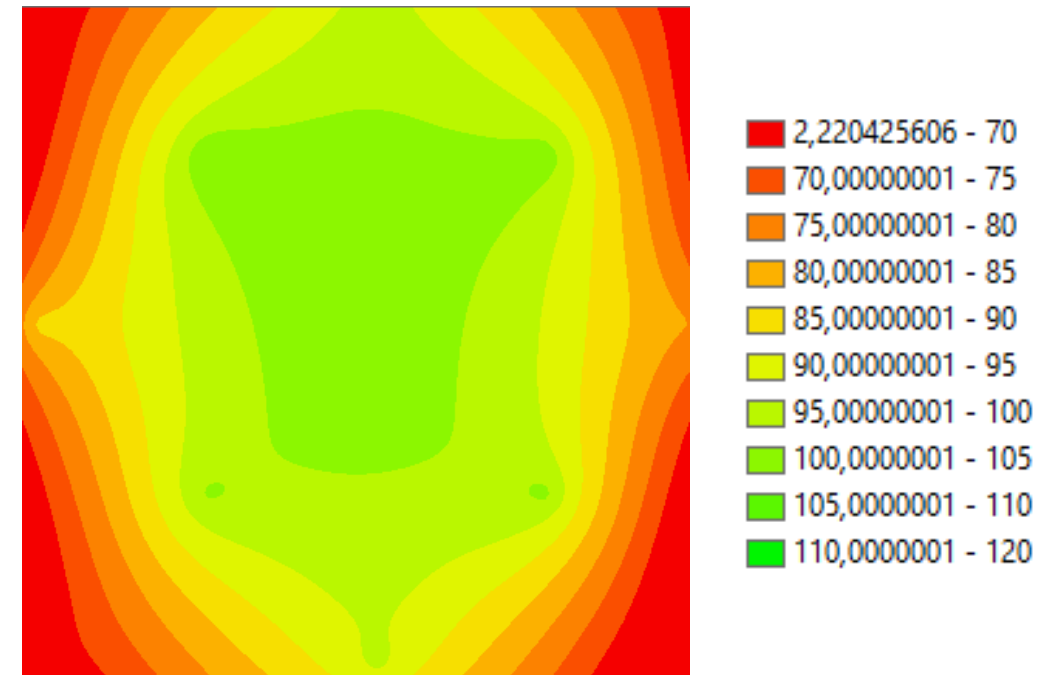


Tested nozzles – rainfall characteristics

4 nozzles were tested on the plot 1x1 m

Nozzle	Type	Pressure (bar)	Height (m)	Christiansen uniformity index (%)	Kinetic energy (J/m ² /h)	Maximal intensity (mm/h)
9570	Swiping	0,85	2,5	86	486	110
9550	Swiping	1,05	2,5	93	311	79
WSQ40	Pulse	0,65	2	71	XX	106
WSQ40	Swiping	0,65	2	79	XX	89

Example of area distribution on 1x1 m area
Showed is rainfall intensity (mm/h)



Conclusion and future development

- Simulator provides various rainfall intensities and Kinetic energies
- Combination of the swipe and pulse production of the rain drop can cover larger plot with relatively small device.
- Optimization of the wind protection is necessary for the on-situ experiments
- The simulator head is designed to be modular - bigger rainfall simulators with the same design and control can be easily produced

Thank you for your attention



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