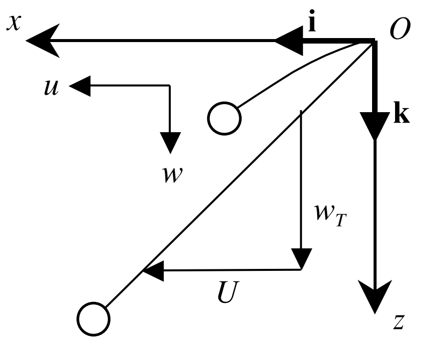

Fig. 1. Definition of the problem: A sphere falling in the transverse winds.

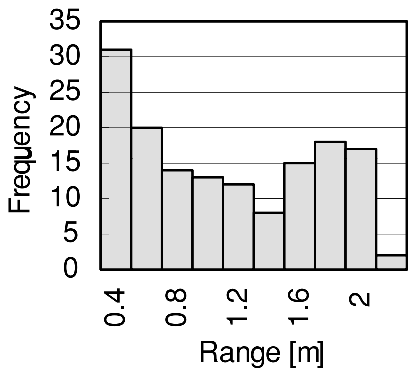

Fig. 2. Range distribution.

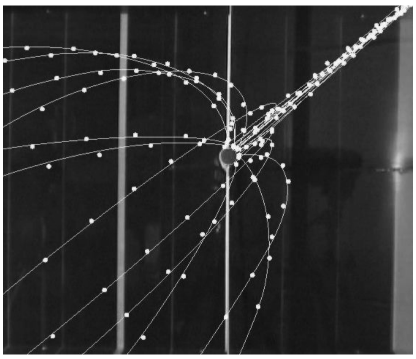

Fig. 3. Trajectories of spheres colliding with a circular bar.

and $\lambda = U/w_T$; in the equations above and hereafter u, w and t are used as nondimensional quantities; the initial condition is given by $\mathbf{v}(0) = \lambda\mathbf{i}$; the vectors $\mathbf{i}$ and $\mathbf{k}$ are the unit vectors in the horizontal and vertical directions, respectively. As shown above, the basic equation is a variation of Riccati equation in a two-dimensional vector form.

Initially $\mathrm{d}z/\mathrm{d}x = w/u = \lambda^{-2} < \lambda^{-1}$, if $\lambda > 1$. Since $\mathrm{d}z/\mathrm{d}x = \lambda^{-1}$ is the conventional formula, the initial locus comes above the straight line of the formula as shown in Fig. 1 for $\lambda > 1$.

Thus the *initial* mechanism is found to be the driving force of transporting samaras farther in case of the transverse wind of $U > w_T$.

3. A Sphere Colliding with a Circular Cylinder in the Transverse Winds

3.1 Motivation

Wind dispersal of samaras is affected by the existence of branches in forests. We tried examining this particular effect by the wind-tunnel experiments using spheres for samaras and a circular cylinder for a branch.

3.2 Experiments

The test section of our blow-down wind tunnel is 0.6 m high, 0.6 m wide, and 1.8 m long; we model the branch by a circular cylinder with 16 mm diameter placed transversely 0.34 m high from the floor and 1.5 m upstream from the end of the test section; we drop plastic spheres with 15 mm diameter through the hole on the wind tunnel ceiling where is 0.26 m high and 0.3 m upstream from our branch; wind velocity is fixed at $U = 5.0$ m/s.

The result is that our branch acts as a springboard rather than an obstacle: the flight range without the branch is on average 0.625 m with 0.037 m standard deviation, while the flight range with the branch is on average 1.11 m with 0.604 m standard deviation. Figure 2 shows the histogram of the flight range with the branch. It is apparent there are two peaks that stand for the flight ranges with upward and downward leaps. Figure 3 shows typical flight trajectories. Spheres leap markedly, although the coefficient of restitution is found to be as low as 0.347.

3.3 Annotation

We observed both top and back spins of spheres, and hence both positive and negative Magnus effects account for the double-peak distribution in the Range histogram, but this alone is not the entire cause of phenomena. The circular cylinder and its wake displace flow around it and hence trajectories of flying spheres, although quantitative explanation is not in our hands yet.

4. Conclusion

When we come across with problems complex in situations or geometries, it is quite useful to introduce spherical approximations to those problems. Such conceptual experiments surely lead us to divergent creative thinking, which then converges to the final solution.

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