Claims

1. A method of operating a mechanical seal assembly (1) having a mechanical seal (2) with a rotating sliding ring (3) and a stationary sliding ring (4) defining a sealing gap (5) between the sliding surfaces thereof, comprising the steps of:

   - collecting operating data and/or environmental data of the mechanical seal (2),
   - transmitting the collected operating data and/or environmental data to a digital twin (31) of the mechanical seal (2),
   - simulating and monitoring the operation of the mechanical seal (2) using the digital twin (31) based on the transmitted operating data and/or environmental data of the mechanical seal (2), and
   - retransmitting a simulation result and/or data of the digital twin, and wherein during the step of retransmitting the simulation result and/or the data, operating commands for the mechanical seal (2) are additionally co-transmitted.

2. The method according to claim 1, wherein the simulating and monitoring the mechanical seal (2) is continuously performed based on currently collected operating data and/or environmental data of the mechanical seal (2) as well as preceding simulation results.

3. The method according to one of the preceding claims, wherein the operating data and/or environmental data collected from the mechanical seal (2) are analyzed using a system computer (20) at the mechanical seal (2) and the analyzed data are transmitted to the digital twin (31).

4. The method according to one of the preceding claims,

   - wherein the collected operating data and/or environmental data of the mechanical seal (2) are filtered using a first filter (21) prior to being transmitted to the digital twin and/or
   - wherein the simulation results and/or data of the digital twin (31) are filtered using a second filter (32) prior to being transmitted to the mechanical seal (2) and/or
   - wherein a reduction of the data is performed prior to the step of transmitting.

5. The method according to one of the preceding claims,

   - wherein when processing the collected operating data and/or environmental data in the digital twin a trend analysis is performed using the collected operating data, and/or
   - wherein when processing the operating data and/or environmental data in the digital twin, clustering of the collected operating data is performed, and/or

- wherein the digital twin (31) is a learning system.

6. The method according to one of the preceding claims, wherein the collected operating data of the mechanical seal (2) are selected among data on temperature, pressure, rotational speed, leakage, gap height at the seal gap (5), vibrations at the mechanical seal, structure-borne sound, surface sound, stresses and/or deformations of the sliding rings, occurrence of contact of the sliding surfaces of the sliding rings and/or wear at the mechanical seal.

7. A mechanical seal assembly comprising:

- a mechanical seal (2) having a rotating sliding ring (3) and a stationary sliding ring (4), defining a sealing gap (5) between the sliding surfaces thereof, and having a plurality of sensors (11, 12, 13, 14, 15), the sensors being configured to detect various operating data and/or environmental data of the mechanical seal (2),
- a central computer (30) comprising a digital twin (31) of the mechanical seal (2), the central computer (30) being configured to simulate and monitor an operation of the mechanical seal (2) using the digital twin,
- a transmitter-receiver device configured to transmit the detected operation data and/or environment data of the mechanical seal (2) to the central computer (30) and to receive simulation results of the digital twin (31), and
- a system computer (20) which is configured to process and/or reduce the collected operating data and/or environmental data of the mechanical seal assembly (2), wherein the system computer (20) comprises a configurable second digital twin (22).

8. The mechanical seal assembly according to claim 7, wherein the system computer (20) is configured to filter the collected operating data and/or environmental data of the mechanical seal (2) using a first filter (21).

9. The mechanical seal assembly according to one of the claims 7 or 8, wherein the central computer (30) is configured to perform a trend analysis and/or a clustering of the collected operating data and/or environmental data of the mechanical seal (2) using the collected operating data and/or environmental data.

10. The mechanical seal assembly according to one of the claims 7 to 9, wherein a cloud computer (40) is interposed between the central computer (30) and the system computer (20).

11. The mechanical seal assembly according to one of the claims 7 to 10, wherein the digital twin (31) and/or the second digital twin (22) is configured as a learning system.